38th Scientific Meeting
22-26 May 2017

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UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO

UNIDAD ACADÉMICA YUCATÁN

UADY

CAMPUS DE CIENCIAS BIOLÓGICAS Y AGROPECUARIAS

FACULTAD DE MEDICINA VETERINARIA Y ZOOTECNIA

AMLC
Association of Marine Laboratories of the Caribbean
2017
MEETING
MÉRIDA
YUCATÁN MX

AMLC HOSTS 2017

ILEANA ORTEGÓN AZNAR

ASSOCIATE PROFESSOR, MARINE BIOLOGY

TROPICAL MARINE RESOURCES, DEPARTMENT CHAIR

UNIDAD ACADÉMICA YUCÁTAN

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XAVIER CHIAPPA-CARRARA, COORDINATOR GENERAL

UNIDAD ACADEMICA DE CIENCIAS Y TECNOLOGIA

UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO,

YUCATÁN

UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO
POR MI RAZA HABLARA EL ESPIRITU

UNIDAD ACADÉMICA
YUCATÁN

AMLC HOSTS 2017

DALILA ALDANA ARANDA

INVESTIGADORA 3D

CINVESTAV IPN

PREMIO NACIONAL AL MÉRITO ECOLÓGICO

MÉRIDA, YUCATÁN, MÉXICO

PLENARY

Monday, 22 May 2017

Ernesto Weil

Professor: Coral Reef Biology, Ecology and Systematics

University of Puerto Rico, Mayaguez

Marine Communities in a Changing Sea: Doomsday or a Transitional State?

Ernesto Weil is a Full Professor at the Department of Marine Sciences, University of Puerto Rico at Mayaguez. He is a biologist graduated at Universidad Central de Venezuela and holds a Ph.D. in Zoology from the University of Texas at Austin. He is a member of the CARICOMP network program of Marine Laboratories, Chair of the Science Committee of the Association of Marine Laboratories of the Caribbean, Co-PI in three long term projects, CRES-NOAA "Integrating Science and Management in the Caribbean" (2003-2007) and "Structure and dynamics of deep reefs in the south coast of Puerto Rico" (2006-2009), and the Coral Disease Working Group of the GEF-World Bank program on Coral Reef Targeted Research and Capacity Building (2005-2009). His main fields of research are coral reef biology and ecology.

PLENARY

Tuesday, 23 May 2017

Lucy Bunkley Williams
Retired Professor & Former Chair
Department of Biology
University of Puerto Rico at Mayaguez

The AMLC: 60 Years of Collaborative Climate Change Research and Advocacy

Lucy retired in 2012. Her main interests are fish parasites, fish diseases, and aquatic animal health. Other work showed that Coral-Reef Bleaching and Sea Turtle Fibropapillomas were worldwide events. Lucy described and named new diseases, 2 new genera and 50 new species. Lucy authored 197 peer-reviewed papers and 3 books (one in Spanish). She was Co-Chief Scientist on 5 week-long missions in the NOAA Hydrolab Undersea Habitat in St Croix, USVI, and on several major scientific cruises. Lucy was the Secretary-Treasurer of the AMLC for many years and the AMLC Student Presentation Award was named in her honor. She is President of the International Friendship Club. She was honored by induction into the Women Divers Hall of Fame and with the Platinum Pro 5000 Award. Lucy is a Distinguished Woman Graduate of Auburn University. A genus and 6 species have been named in her honor. These include *Williamsius* [gillworm], 2 isopods, a copepod, fluke, thornyheaded worm, and another gillworm. The latest was *Renocila bertlucy*. Lucy has also taken up crafting handmade, original, sea-inspired jewelry.

PLENARY

Thursday, 25 May 2017

Philip Kramer
Director
Florida Institute of Oceanography
University of South Florida

The AGRRA Program at 20 years old: Perspectives on Monitoring and Policy and the Future of Caribbean reefs

Trained as a tropical marine geologist with a Ph·D· from the University of Miami's Rosenstiel School of Marine and Atmospheric Science, Phil has spent much of his career advancing tropical ecosystem monitoring, management, and restoration of coral reefs and mangroves· He is the co-founder of the Atlantic and Gulf Rapid Reef Assessment Program (AGRRA), which is a widely accepted as the standard scientific monitoring protocol for reefs and currently houses one of the largest databases on coral reef condition (www·agrra·org)· He also established the Florida Reef Resilience Program (FRRP) disturbance response monitoring program which continues to collect annual data on the condition of corals during summer bleaching events (www·frrp·org)· Phil has led numerous scientific oceanographic expeditions to some of the most remote and extensive reef systems of the Caribbean including the south coast of Cuba, the Mesoamerican reef, Andros Island the southern Bahamas, the north coast of Haiti to name a few· Phil resides in St· Petersburg with his wife and three children·

PLENARY

Friday, 26 May 2017

Roberto Iglesias-Prieto
Professor, Coral Biology
Penn State University

The future of coral reefs in the XXI century: a physiological perspective

Roberto Iglesias-Prieto, professor of biology, focuses his research on coral biology. One of Iglesias-Prieto's most recent contributions demonstrated an important function of the nonliving components of coral in capturing light that is used by the living components in photobiological processes, showing how global warming patterns are adversely affecting these communities. Before joining the faculty at Penn State, Iglesias-Prieto was professor in the Instituto de Ciencias del Mar y Limnologia at the Universidad Nacional Autónoma de México from 1996 to 2016 and was head of the Reef Systems Academic Unit there from 2008 to 2014. He was senior scientist in the Department of Ecology at the Centro de Investigación Cientifica y Estudios Superiores de Ensenada in Mexico from 1994 to 1996 and a postdoctoral fellow at the University of California, Santa Barbara from 1993 to 1994. Iglesias-Pietro earned his doctoral degree in aquatic and population biology at the University of California, Santa Barbara in 1993.

Awards Banquet 2017

Ernest (Bert) Williams

Thursday, 25 May 2017 (8 pm) Professor Emeritus: University of Puerto Rico at Mayaquez Marine Science & Biology Department

History of the Association of Marine Laboratories of the Caribbean (8 pm)

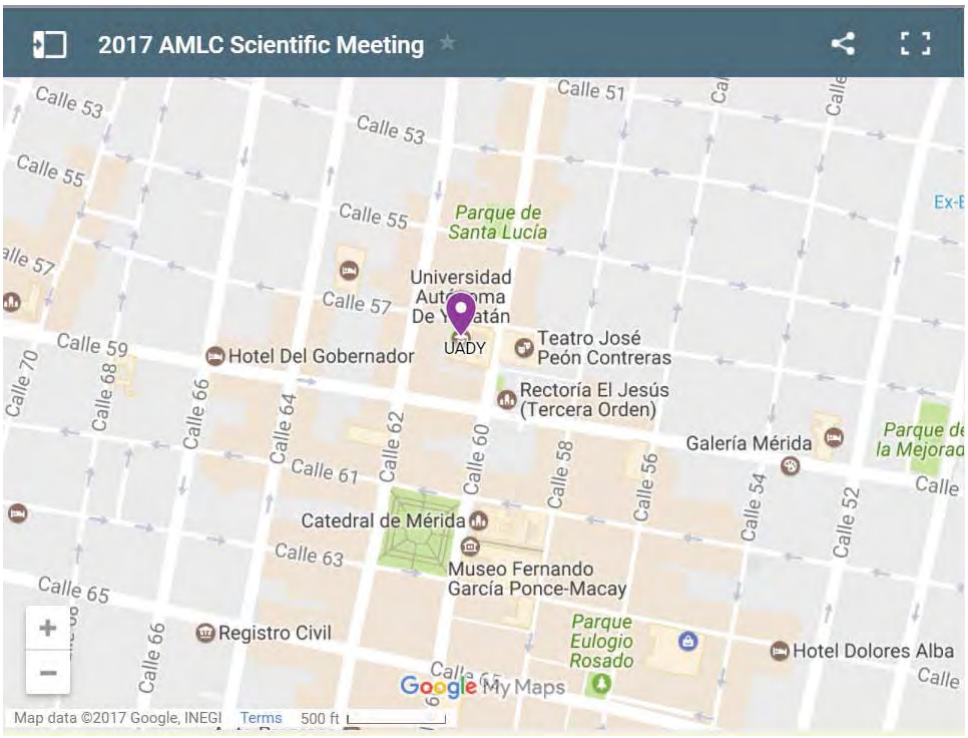
Ernest Williams

Telephone calls and travel was both expensive, difficult, and often unreliable in the old Caribbean. To exchange knowledge, one had to travel to meetings in the USA or Europe, this could seldom be done, and even then, the meetings would have nothing to do with the tropics. In 1957 marine biology on Caribbean islands was a bit like Robinson Crusoe. Juan Rivero[1] founded the Association in 1957[2] by inviting the heads of Caribbean island marine labs (The Founding Fathers) to a meeting in Mayaguez. With no disparagement intended, they had no idea how to proceed. They could not even agree on a name.[3] With all grandiose plans sinking, they could only agree on holding the next meeting. Amazingly, that was about all the AIMLC accomplished for the next 2 generations, with only one major gap. We just held meetings, which was not that bad, but not that great. Most Caribbean marine biology students could not even dream of attending a scientific meeting and presenting a paper. The AIMLC brought the meetings to them. In 1977, Lucy and I tried to expand the Association beyond small marine stations, and even, Heaven forbid, onto continents. This drew some ire from the surviving Founding Fathers. Beyond that, we just continued to hold meetings. In 1992, when we pasted the torch to others, the Association went through some re-organization pains but emerged a bigger, better organization with broader goals and initiatives. Where do we go from here? We have a few outrageous suggestions.

Footnotes

[1]Dr. Juan Arturo Rivero Quintero (1923-2014), AMLC Founder and first recipient of the Juan Rivero Life Time Achievement Award. [2]Not 1956, as on the AMLC web page, which I never could correct. [3]Three names were published, but many others were floated. Including a few one cannot mention.

Please join us for the Scientific Meeting starting each morning at 8 am at the Main Building at the Universidad Autonoma de Yucatan (UADY), Calle 60 491A

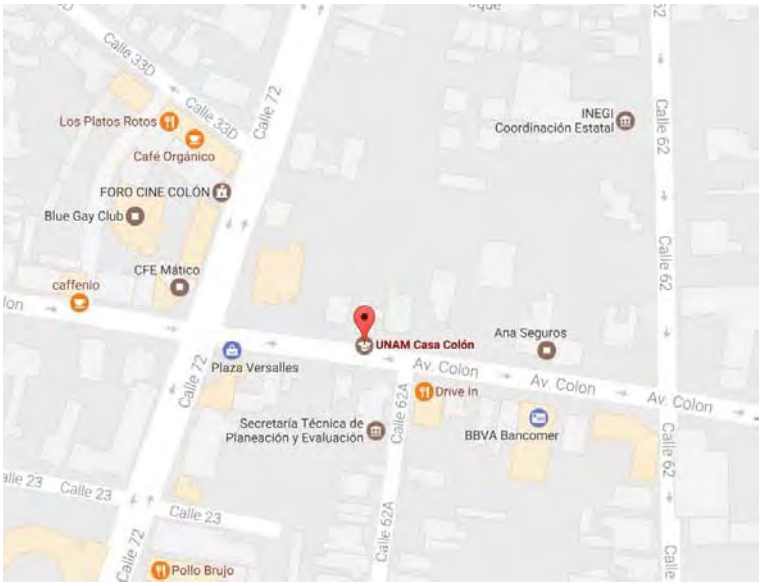


ON Tuesday Evening the Poster Session will be held in the Esplanade of the UADY Campus with Wine Bar & Hors d'oeuvres

https://goo.gl/maps/GhngHw7TsiM2

Welcome to Merida, Mexico

Please join us for Registration starting on Sunday, May 21st at 5 pm at the UNAM CASA COLÓN on Avenue Colon #503 F



ON SUNDAY EVENING: THERE IS A WELCOME RECEPTION FROM 6 - 8 PM WITH OPEN BAR AND HOR O'DOERVRES

https://goo.gl/maps/pYvi6SU6z1x

Student Social

Students: You are invited to a student social on Wednesday evening after the field trips from 5 - 10 pm.

You will receive complimentary drink tickets that can be used only on Wednesday between 6 - 10 pm at the Pipiripau Bar, Calle 62 463

STUDENT MIXER

AMLC 2017 MEETING MÉRIDA YUCATÁN MX

TICKET VÁLIDO POR:

$ 70.00 MXN

Pipiripau Bar
Calle 62 463, Centro
Mérida, Yucatán

No cash back on ticket if full amount is not used
The voucher is ONLY VALID for the day of the Student Mixer—May 24th 5pm-10pm

FINAL PROGRAM 38th AMLC SCIENTIFIC MEETING

MERIDA YUCATAN MEXICO (MAY 21-26, 2017)

SUNDAY, MAY 21			
09:00-17:00		AMLC Board of Directors Meeting	
17:00-21:00		Registration at Casa Colon (5 - 9 pm) & Welcome Reception (6 - 8 pm)	
END OF DAY 0 (MAY 21)			
		MONDAY, MAY 22	
07:00 - 8:00		Registration	
07:45 - 8:00		LOAD presentations	
08:00 - 8:15		Opening ceremony (Local Host)	
Time	**Section**	**Authors**	**Title**
08:15-09:00	Plenary Speaker	Dr. Ernesto Weil	Marine Communities in a Changing Sea: Doomsday or a Transitional State?
09:00 -09:15	GLOBAL ISSUES – Climate Dynamics	Lewis CL, Neely KL, Rodriguez-Lanetty M	Adaptation and resilience in a changing climate: cryptic Symbiodinium sp. in Florida's pillar coral offer a glimmer of hope
09:15 - 09:30	GLOBAL ISSUES – Climate Dynamics	Burn MJ & Palmer SE	Harmonizing marine and terrestrial paleoclimate archives to better understand caribbean climate dynamics
09:30 - 10:00	GLOBAL ISSUES – Climate Dynamics	Duran A, Burkepile DE, Collado-Vides L, Ferrer VM. Gonzalez SP, Palma L, Ramos A, Shantz A.	Influence of global and local stressors on the coral reefs near Havana, cuba
10:00 10:30		Coffee Break	
10:30 10:45	GLOBAL ISSUES – Fish repro.-Thermal stress	Brulé T, Renán-Galindo X, Colás-Marrufo T	Potential impacts of climate change in reproductive phenology of economically important fishes from Southern Gulf of Mexico
10:45 11:00	GLOBAL ISSUES – Fish repro.-Thermal stress	Martínez-González N, Roberson L, Toledo Hernández C	Impact of water temperature increase in the photosynthesis and calcification/growth rate of three life stages of Porites astreoides
11:00 11:15	ECOLOGY-GENERAL – Sargassum	Johnson DR, Franks JS	Recent influx of pelagic Sargassum onto the cuban coastline
11:15 11:30	ECOLOGY-GENERAL – Sargassum	Van Tussenbroek BI et al	Severe impacts of Sargassum spp. brown tides on near-shore seagrass communities in the Caribbean
11:30 11:45	ECOLOGY-GENERAL – Sargassum	Oxenford HA, Franks J, Johnson D	Rugosity characterization on reef environments and its implications for beach protection services
11:45 12:00	ECOLOGY-GENERAL – Sargassum	García-Sánchez M, Graham C, Álvarez-Filip L, van Tussenbroek B	The effects of nutrient additions on the growth and photosynthesis of pelagic Sargassum in Caribbean coastal areas based on in-situ experiments
12:00 13:30		Lunch	
13:30 13:45	ECOLOGY-GENERAL – Symbiodinium	Castillo-Medina R, Villanueva MA	Differential phosphorylation of a hsp-like protein from cultured symbiodinium under various light conditions
13:45 14:00	ECOLOGY-GENERAL – Symbiodinium	Bell AC, Burdett H, Hennige S, Kamenos N	The potential for non-scleractinian hosts to act as Symbiodinium
14:00 14:15	ECOLOGY-GENERAL – Sea grasses	Islas-Flores T, Pérez-Cervantes E, Nava-Galeana J, Guillén G, Villanueva MA	Rack1 and interacting proteins from Symbiodinium
14:15 14:30	ECOLOGY-GENERAL – Sea grasses	Barba Santos MG, Van Tussenbroek BI	Twenty-two years of seagrass monitoring at the puerto morelos caricomp site: discerning natural and human-induced changes
14:30 14:45	ECOLOGY-GENERAL – Sea grasses	Samper-Villareall J, Van Tussenbroek BI, Cortés J	Seagrasses of Costa Rica: from the mighty Caribbean to the dynamic meadows of the eastern tropical Pacific
14:45 15:00	ECOLOGY - BIOLOGY – Algae	Collado-Vides L, Duran A, Armenis E, Cassano V, Burkepile D, Shantz A, Palma L, Diaz-L. J, Senties A, Toyota Fuji Mi	Seasonal recruitment and survival strategies of Palisada cervicornis comb. nov. (Ceramiales, Rhodophyta) in coral reefs
15:00 15:15	ECOLOGY - BIOLOGY – Queen conch	Guppy R, Henry T	Connectivity of populations and gene flow in Tobago's queen conch Lobatus gigas (linnaeus, 1758) population
15:15 15:45	ECOLOGY - BIOLOGY – Queen conch	Aranda D. and Sanchez Crespo M	Calcification of larvae of Strombus (L.) gigas in the Caribbean
15:45 16:00		Coffee Break	
16:00 16:15	GY - IGY – Queen conch	Dennis MM, Tiley K, Lewin-Smith MR, Williams BH, Freeman MA	Ultrastructural and molecular characterization of digestive gland inclusions in the queen conch (Lobatus gigas)

16:15 16:30	ECOLO BIOLC Red tides	González-Romero R, Suarez-Ulloa V, Rodríguez-Casariego J, Garcia-Souto D, Díaz G, Smith A, Pasantes JJ, Rand G, Eirin-López JM	Effects of Florida red tides on histone variant expression and dna methylation in the eastern oyster Crassostrea virginica
16:30 16:45	BIOLOGY- GENERAL Lion Fish	Klatt C, Koot M, Elmer F, Peachey R	Determination of the degradation rate of lionfish edna in the laboratory
16:45 17:00		Hevia-Montiel N, Molino-Minero-Re E, Chiappa-Carrara X.	Study of discrete morphometric characteristics of saggittae otolith of lionfish (Pterois volitans) in Puerto Morelos
17:00 17:15		Freeman MA, Brigante E, Magnier B, Dennis MD	Novel parasites of invasive lionfish from St Kitts and their potential use as biological tags
17:15 17:30	ECOLOGY - ICHTHYOLOGY	Ron I. Eytan, Micheal E. Hellberg, Max D. Weber	Island hopping: coral reef fish phylogeography across the Caribbean
17:30 17:45		Marin Coria EJ, Enriquez C, Chiapa Carrara X	Thermohaline dynamics and the effect of extreme salinity gradients in the ichthyofauna distribution in a tropical coastal lagoon
17:45-17:30		Vallès H, Kramer DL, Hunte W	Evidence of strong density-dependent losses soon after settlement for Sparisoma parrotfishes along the west coast of Barbados
END OF DAY 1 (MAY 22)			

TUESDAY, MAY 23			
07:00 - 8:00		Registration	
07:45 - 08:00		LOAD presentations	
08:00-08:15		Introduction & Announcements	
08:15-09:00	Plenary Speaker	Dr. Lucy Bunkley Williams	The AMLC, 60 years of collaborative climate change research and advocacy
09:00 - 9:15	GLOBAL-ISSUES Diseases	Weil E, Rogers C. and Croquer A	Octocoral diseases in a changing ocean
09:15 - 9:30		Hayes N.K., Walton C.J., Brinkhuis V., Ruzicka R., Gilliam D.	Stony coral mortality associated with the disease outbreak along the Southeast Florida reef tract
09:30 - 10:00		Bock ME, Fogarty ND	Exploring disease dynamics in the staghorn coral, Acropora cervicornis: genotypic response to pathogen transmission techniques
10:00 10:30		Coffee Break	
10:30 10:45	GLOBAL-ISSUES Diseases	Hightshoe MV, Miller S, Fogarty ND	Disease resistance in the threatened staghorn coral, Acropora cervicornis
10:45 11:00		McField M, Kramer P, Rueda M, Giró A, Drysdale I, Muñiz-Castillo AI, Rivera-Sosa A, Arias-González JE.	Coral bleaching in the Mesoamerican region (2015-2016)
11:00 11:15		Dougan K, Ladd, Fuchs C, Vega Thurber R, Burkepile D, Rodriguez-Lanetty M.	Nutrient enrichment suppresses an innate immunity pathway in the coral Porites porites and recovery from predation
11:15 11:30		Tilei K, Yen I, Dennis M, Freeman M	A histopathological survey of queen conch, Lobatus gigas, health in St
11:30 11:45	Histopathology-Proteins	Brown T, Waikel P, Bhedi C, Lewis C, Richardson LL, Rodriguez-Lanetty M	Finding the needle in the hay stack. use of the cnidarian model system, exaiptasia pallida to screen potential disease causing pathogens in corals
11:45 12:00		Abdel-Salam HA, Donia AH, A.M. Ali AH, El Shaarawy HM,Hegazy L	Heat shock protein gene hsp70 as an indicator for determining thermal stress response in Stylophora pistillata from Gulf of Suez, Red Sea
12:00 13:30		Lunch and Set up Posters	
13:30 13:45	ECOLOGY-GENERAL Sea turtles	Martínez López IG , van den Akker M, Walk L , van Katwijk M, Van der Heide T, van Tussenbroek B	Grazing by green turtles induced a community shift from climax to early successional species in the Caribbean
13:45 14:00		Uribe-Martinez A, Correa Liceaga MLA, Cuevas E	Habitat suitability for sea turtles in the Gulf of Mexico: a future scenario
14:00 14:15		Jobsis P, Jossart J, Johansen L	Extremely high site fidelity of juvenile green and Hawksbill sea turtles at night
14:15 14:30	BIOLOGY - ECOLOGY Reproduction	Harper L, Elijah O'Cain, Lindsay K. Huebner, Rob Ruzicka, Daniel F. Gleason, Nicole D. Fogarty	Variability in coral and octocoral recruitment along the florida reef tract
14:30 14:45		Vollmer AA and Fogarty ND	How does colony size and density influence paternity in a brooding coral
14:45 15:00		Rivera-Irizarry F, Mercado-Molina A, Fonseca-Miranda JS, Aponte-Rolón GA & Sabat AM	Physiological and immunological dynamics of scleractinian corals differing in reproductive strategy: a field-based experiment
15:00 15:15	TAXONOMY Molecular	O'Cain ED, Gleason DF, Frischer ME, Fogarty ND, Ruzicka R	Development of a molecular assay for caribbean coral identification
15:15 15:45		Coffee Break	

15:45 16:00	CONSERVATION-MANAGEMENT	Pilar coral	Moore J, Lewis C, Neely K, Graves S, Ripple K, Vaughan D, Woodley C	Multi-agency rescue of the threatened pillar coral along the Florida reef tract
16:00 16:15			Neely K, Lewis C, Vaughan D, Woodley C, Graves S, Moore J	Collapse, rescue, and potential restoration of Florida's pillar coral
16:15 16:30		Resilliency	McCoy C, Pilly SS, Turner J	Marine protected areas and coral reef resiliency, Cayman Islands
16:30 16:45		Protection	Acevedo Ramírez CA, Mariño-Tapia I	Rugosity characterization on reef environments and its implications for beach protection services
16:45 17:00		Social imput	Vardi T	Recommendations and outcomes from the November 2016 workshop to advance the science and practice of Caribbean coral restoration
17:00 17:15			Heinen JT, Collado-Vides L	Managerial implications of perceptions, knowledge, attitudes and awareness of residents regardinf Puerto Morelos Reef National Park, Mexico
17:15 17:30		Citizens	Suleiman-Ramos SE, Hernandez-Delgado EA, Mercado-Molina AE, Candelas-Sanchez F.	Community-based scientific citizens: a strategy to manage coastal resources in response to the effects of climate change
17:30-17:45			SET UP POSTERS	
18:00-21:00			Poster Session	
			END OF DAY 2 (MAY 23)	

			Wednesday, May 24 Field trips	
07:00 - 12:00			Registration desk open & Field Trips	
18:00-22:00			Student Social	
			END OF DAY 3 (MAY 24)	

			Thursday, May 25	
07:00 - 8:00			Registration	
07:45 -08:00			LOAD presentations	
08:00-08:15			Introduction & Annouuncements	
08:15 - 9:00		Plenary Speaker	Dr. Philip Kramer	The AGRRA Program at 20 years old: Perspectives on Monitoring and Policy and the Future of Caribbean reefs
09:00 - 9:15	GLOBAL-ISSUES	Anthropology Reefs	Zawada DG, Yates KK	Regional-scale elevation changes in modern coral reef ecosystems
09:15 - 9:30			Rubio-Cisneros NT , Moreno-Baez M , Sáenz-Arroyo A, Rissolo D4 , Glover J , Gotz C6 ,Antele F, Rissolo D4 , Glover J , Gotz C6 , Antele F, Salas S , Herrera-Silveira J	Long-term coastal exploitation at Holbox island, México
09:30 - 10:00		Blue Carbon	Herrera Silveira JA, Camacho Rico A, Morales Ojeda S, Medina Gómez I, Pech M, Ramírez Ramírez J, Carrillo Baeza L, López Herrera M, Pech Poo E, Caamal Sosa JP, Hernández CT	Blue carbon ecosystems of Mexico
10:00 10:30			Coffee Break	
10:30 10:45	ECOLOGY-GENERAL	Acroporids	Fogarty ND, Hightshoe MV, Bock MV, Budd AF, Kitchen SA, Devlin-Durante M, Baum IB	Extensive phenotypic variation among the three Caribbean Acroporid corals
10:45 11:00			Rodriguez-Casariego J, Campbell S, Ladd M, Shantz A, Roberts S, Burkepile D, Eirin-Lopez J	Nutrient loading hinders mechanisms involved in the epigenetic maintenance of genome integrity in the stony coral *Acropora cervicornis*
11:00 11:15			Mercado-Molina AE, Ruiz-Diaz CP, Sabat AM	On the relationship between partial mortality and the demographics of *Acropora cervicornis*
11:15 11:30			Goldenberg ED, Goergen EA, Gilliam DS	Fish assemblages on outplanted Acropora cervicornis reefs and natural reefs in southeast, Florida, USA
11:30 11:45	CONSERVATION-MANAGEMENT	Staghorn corals	Cavasos K, Bhat M	Cost-benefit analysis of restocking staghorn coral *(Acropora cervicornis*) populations on the Florida reef
11:45-12:00			McClean R and Oxenford HA	Mapping the recovery of elkhorn coral on the West coast of Barbados

12:00 13:30			Group Photo and Lunch	
13:30 13:45	ECOLOGY - GENERAL	Staghorn corals	Schleier S, Nickles N, Forrester G	Acropora spp. restoration effects on reef community response in the Caribbean
13:45 14:00			Martinez SJ, Cavada F, Agudo E, Cappelletto J, Cróquer A.	Los Roques National Park: still a refuge for Staghorn coral?
14:00 14:15			Carne L, Kaufman L, Scavo K, Gleason A, Vaughan D	Update on reef replenishment efforts in Belize: success indicators and expansion plans
14:15 14:30	ECOLOGY - GENERAL	Fish surveys/Molecular	Cruz Motta JJ, Appeldoorn RJ, Scharer M, Appeldoorn E, Olson J, Touhy E, Olmeda M, Aragones C, Gonzalez F , Ortiz W.	Observer effects and calibration in underwater visual surveys of fish: a multivariate approach
14:30 14:45			Glaholt C, Erickson H, Grubbs B, Wishon A, Collins A, Shaw J, Peachey R	eDNA as a tool to monitor invasive species
14:45-15:00			Marley Guy SA, Lawrence A, Hayden B, Phillip Dawn AT	Carbon sources supporting food chains in a mangrove forest and adjacent intertidal mudflats: a stable isotope technique for assessing ecosystem connectivity
15:00-15:15		Genetic	Emms MA, Saenz Agudelo P, Gatins RA, Berumen ML, Scott A, Hobbs JP, Frish A, Mills S, Beldade R, Nanninga G	. Broad-scale population genetics of the host sea anemone, Heteractis magnifica
15:15-15:45			Coffee Break	
15:45-16:00	ECOLOGY - GENERAL	Coral Reefs	Rosado-Torres, A, Mariño-Tapia I, Acevedo-Ramírez C	Effects of submarine groundwater discharges on benthic cover and reef rugosity in Puerto Morelos, Quintana Roo
16:00-16:15			Jones NP, Walton CJ, Brinkuts V, R. Ruzica, Gillian DS	Quantitative analysis of spatial and temporal variance in benthic cover in a high latitude reef system offshore southeast Florida, USA
16:15-16:30			Alvarez-Filip L, González-Barrios FJ, Carricart-Ganivet JP, Horta-Puga G, Gonzalez-Posada A, Iglesias-Prieto	Shifts in coral-assemblage composition drives the functional collapse of Caribbean coral reefs
16:30-16:45		Thermal	Duffing-Romero MD, Nemeth RS , Ault JS , Luo J , Pittman SJ	Does variability in water temperature and dissolved Oxygen influence the movement patterns of two Caribbean fish?
16:45-17:00		Cliona	Trew H, Valles H	Prevalence of the excavating sponge Cliona delitrix in a near-shore artificial reef system
17:00-17:15			Tewfik A, Loh TL	Giant barrel sponges, Xestospongia muta, are dominant structures on a Caribbean reef
19:00-22:00			BANQUETE 20:00 Williams History of AMLC	
			END OF DAY 4 (MAY 25)	

			Friday, May 26	
07:00 - 8:00			Registration	
07:45 - 8:00			LOAD presentations	
08:00-08:15			Introduction & Annouuncements	
08:15 - 9:00		Plenary Speaker	Dr.Roberto Iglesias-Prieto	The future of coral reefs in the XXI century: a physiological perspective
09:00 - 9:15	GLOBAL-ISSUES	Diseases	Richardson LL, De Bhedi C, Sikaroodi M, Gillevet P.	A new approach to understanding the etiology of black band disease
09:15 - 9:30			Jones S, Rotjan R, Foltz Z, Herman S, Harper L, Vollmer A	Consecutive winter bleaching events observed on deeper reef sites near Carrie Bow Cay, Belize
09:30 - 10:00			Dorrestein E, Dennis MM	Macroscopic pathology of Orbicella annularis and O. faveolata in St. Kitts
10:00-10:30			Coffee Break	
10:30-10:45	GLOBAL-ISSUES	Diseases	Elmer F, Roth M, Rodriguez L, Giametti S, Hills A, Hoag M, Peachey R.	A Caribbean wide disease affecting ocean surgeonfish (Acanthurus bahianus)
10:45-11:00		pathological tudies	Toledo-Hernández C, Ruiz-Diaz CP, Díaz-Vázquez LM, Santiago V, Rosario-Berrios DN, García-Almedina DM, Roberson LM.	Comparison of chemical compounds associated with sclerites from healthy and diseaed sea fan corals (Gorgonia ventalina)

11:00-11:15	Histo	Hill K, Dennis MM, Rajeev S1, Stewart K — Histopathological investigation of embryonal mortality in leatherback sea turtles (Dermochelys coriacea) in St. Kitts
11:15-11:30		CLOSE MEETING
11:30-11:45		Sargassum Workshop and Disease Forum-Marine Diseases in a changing sea
11:45-12:00		Sargassum Workshop and Disease Forum-Marine Diseases in a changing sea
12:00-13:30		Lunch
13:30-13:45		Sargassum Workshop and Disease Forum-Marine Diseases in a changing seaSargassum Workshop
13:45-14:00		Sargassum Workshop and Disease Forum-Marine Diseases in a changing sea
14:00-14:15		Sargassum Workshop and Disease Forum-Marine Diseases in a changing sea
14:15-14:30		Disease Forum- Marine Diseases in a changing sea
		END OF DAY 5 (MAY 26)

Posters (Tuesday May 23)

1	Guendulain-García SD, Gómez-Campo K, Mendoza-Quiroz S, Schutter M, Leal-Bautista RM, Banaszak AT	Massive Sargassum landings: alterations in Acropora palmata natural settlement
2	Jaffe M, Shein K	The influence of the geomorphology of coral reefs on the distribution of Acropora species on Little Cayman, Cayman islands
3	Fernandez C, Montenegro K, Collado-Vides L	Monitoring algal and seagrass species diversity changes in a freshwater-flooded, coastal wetland
4	Montenegro K, Fernandez C, Collado-Vide, L	Monitoring algal and seagrass species diversity changes in a freshwater-flooded, coastal wetland
5	Cabrales-Arellano P, Islas-Flores T, Villanueva MA	Expression of the receptor for activated c kinase 1 at different developmental stages of the jellyfish Cassiopea xamachana
6	Graham C, García-Sánchez M, van Tussenbroek B, Álvarez-Filip L	The physiological response of pelagic Sargassum to increased nutrients and Sargassum decomposition under stressful conditions
7	Bonilla-Pizarro AI, Mercado-Molina AE, Hernández-Delgado EA.	Demographic dynamics of fused staghorn coral (Acropora prolifera) in a shallow, high-wave energy urban coral reef.
8	Iporac LA, Collado-Vides L	Does morphology of Penicillus spp. affect its usage as invertebrate habitat?
9	Pérez-Trejo A, Lazcano-Pérez F, Arreguín-Espinosa R, Sánchez-Rodríguez J	Cytotoxic effect of the cubozoan Carybdea marsupialis on cancerous and non-cancerous cells
10	Ortegón-Aznar I, Suarez AM	Algal morphofunctional groups from natural protected areas in the northern coast of the Yucatan peninsula, Mexico
11	Benítez HM, van Tussenbroek BI	Restoration of seagrass in the reef lagoon of Puerto Morelos, Quintana Roo
12	Palmer SE, Gayle PMH, Anderson D, Douglas DL, Charpentier B, Charpentier F, Trench C, Francis PA, Henry D, Creary-Ford M, Thomas SL, Maddix GMM, Buddo D, Webber D, Webber M	Calipers to 3d models: measuring the survival and growth of five reef-building coral species on in situ tree nurseries, Discovery Bay, Jamaica.
13	Núñez Resendiz ML, León Tejera H, Dreckmann KM, Sentíes A	Molecular identification of solieriaceae species (Rhodophyta) in the Yucatan peninsula, Mexico
14	Chuc-Contreras A1, Ortegón-Aznar I1, Collado-Vides L2,3	Calcareous green algae carbon contribution in a tropical sedimentary coast of Yucatan, Mexico
15	Ramírez Beltrán M, Pascual Jiménez C, Sánchez Arteaga A, García Vargas A, Padrón Muñoz A	Effect of exposure to high temperature in cellular response of caribbean spiny lobster, Panulirus argus
16	Crawford RL, Elize HR, Dorrestein E, Sample S, Dennis MM	Spot bleaching in elliptical star coral (Dichocoenia stokesii) in st. kitts
17	Avila-Pech EA, Mendoza-Quiroz S, Guendulain-García SD, Banaszak AT.	Coral restoration in the mexican Caribbean
18	Cox AM, Vallès H	Does unoccupied microhabitat patch size affect early post-settlement demographics in a Caribbean reef fish?
19	Gleason M, Koot M, Peachey R.	Patterns of nutrients and bacteria at near-shore wells and intertidal marine sites in Bonaire, Caribbean Netherlands

20	Guzmán-Rodríguez R, SE Suleimán-Ramos, AE Molina, Candelas-Sánchez F, Hernández-Delgado EA.	Sea urchin relocation increases overall success of urban coral reef compensatory mitigation and rehabilitation
21	Hernández OE, Dreckmann KM, Núñez-Resendiz ML, Sentíes A.	Vicariant processes in Gracilariopsis e.y. dawson (Rhodophyta) in the Yucatan península
22	Nickles K, Schleier-Hernandez S, Forrester G.	Caribbean reef fish response to coral restoration
23	Virwani A, Dennis M, Freeman M	Histological and parasitic assessment of white sea urchins (Tripneustes ventricosus) in Saint Kitts, West Indies
24	Rivera Ortega J, Thomé PE	Immunology of a jellyfish mucus
25	Pérez-Pagán BS, Mercado-Molina AE	Evaluation of artificial corals as an alternative to promote the recruitment of coral reef fish
26	Muñiz-Castillo AI, Rivera-Sosa A, McField M, Rueda M, Giró A, Drysdale I, Kramer P, Arias-González JE	Coral bleaching event in the Mesoamerican reef region and its relation to stressors monitored by remote sensing
27	Maroun V, Stewart K, Poppenga R, Conan A, Dennis M.	Trace metal exposure and hatch success in st. kitts leatherback sea
28	Candelas F, Suleiman SE, Mercado A, Olivo I.	The role of non-governmental organizations and their volunteers in activities for the protection of the marine environment
29	Fonseca-Miranda J, Rivera-Irizarry F, Bruno-Laureano Y, Mercado-Molina AE.	Demographics of the common demosponge Ircinia felix
30	Archilla-Pagán A, Mercado-Molina AE, Rivera-Irizarry F, Sabat AM.	The presence of the sponge Ircinia felix does not facilitate Acropora cervicornis growth and demographics
31	Oxenford HA, Suckoo R, Cox AM, Cox AJ.	Assisted recovery of elkhorn coral: will this help to protect our coastline?
32	Rodriguez S, Banasco M, Duran A, Palma L, Burkepile DE, Collado-Vides L.	The use of Dictyota as a bioindicator of differential nutrient availability in high and low relief reefs in the Florida Keys
33	Chong Sánchez F, Enríquez Díaz M, Aldana Aranda D.	Steroid hormones and their relationship with the reproduction of the gasteropod Strombus pugilis.
34	Rodriguez S, Banasco M, Duran A, Palma L, Burkepile DE, Collado-Vides L.	The use of Dictyota as a bioindicator of differential nutrient availability in high and low relief reefs in the Florida Keys

RUGOSITY CHARACTERIZATION ON REEF ENVIRONMENTS AND ITS IMPLICATIONS FOR BEACH PROTECTION SERVICES.

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Recent studies have demonstrated the importance of rugosity (i.e. structural complexity) in wave energy dissipation and in lagoon water circulation. However, to measure and characterize rugosity in these systems present important technical, logistic and conceptual challenges, including extreme water motion (breaking waves), shallowness, coral fragility and scale dependency. Therefore, the selection of a suitable method within the variety of existing possibilities is very important. In the present study cross-reef bathymetric profiles were performed in a ~25 km long reef system between Puerto Morelos and Cancun cities (Quintana Roo, Mexico) by means of a small catamaran (dimension: 2x1.5 m) equipped with ADCP-Echosounder, differential GPS, and video-camera. After correction by waves, the bathymetric signal was used to evaluate structural complexity with different methodologies, in order to compare results: traditional (dimensionless) rugosity index (RI), standard deviation-based estimates (SD), spectral analysis, fractal-dimension, and Wavelets were used. This measurement method is easy to apply and reproduce. Wavelet analysis was the preferred option, since it is capable of evaluating rugosity height and length (scales 0.3 to 30 m), and its spatial location along the profile. Therefore, this analysis is adequate to find relationships between bottom rugosity and hydrodynamic phenomena at different scales. The other interesting index was the SD that can be related directly with the size of the biggest objects (coral colonies) on the profile. Using the ADCP and GPS data, an estimate of the velocities and the wave dissipation across the reef is also possible to obtain. All estimates showed that the back reef has the highest rugosity for the area. This has strong implications for beach protection as shown with numerical modeling of wave attenuation. Reef structural complexity, continuity of the barrier, and proximity to shore are the main parameters that affect beach dynamics. This information should be considered when planning beach developments in reef-fronted areas.

Estudios recientes han demostrado la importancia de la rugosidad en la disipación de energía de oleaje y en la circulación de sistemas lagunares. Sin embargo, medir y expresar la rugosidad en estos sistemas implica desafíos técnicos, logísticos y conceptuales, por ejemplo, el rápido movimiento del agua en la zona de rompiente, el difícil acceso a las zonas someras, la fragilidad del coral y la dependencia de la rugosidad a la escala. Por ello, la elección de un método adecuado dentro de la gran variedad existen es una tarea difícil e importante a la vez. En el presente estudio se obtuvieron perfiles perpendiculares a la costa en el sistema arrecifal ubicado entre la ciudades de Cancún y Puerto Morelos (aprox. 25km), para ello su utilizó un catamarán (dimensión aprox. = 2x1.5m) equipado con un ADCP-ecosonda, GPS diferencial y una videocámara. Después de realizar una corrección para eliminar el oleaje, la señal de batimetría fue usada para evaluar la rugosidad con las siguientes técnicas: índice tradicional de rugosidad, desviación estándar (DE), análisis espectral, dimensión fractal y análisis

Wavelet. El método de medición (catamarán-ecosonda) muestra ser fácil de implementar y reproducible. En cuanto a las técnicas de análisis, solo el Wavelet permitió obtener tanto la altura como la longitud de rugosidad a diferentes escalas (0.3 a 30m), además de su ubicación espacial a lo largo del perfil, por ello esta técnica es la más adecuada para relacionar a la rugosidad con los fenómenos hidrodinámicos. Otro interesante índice fue la DE que puede relacionarse con la altura de los objetos (colonias de coral) encontrados sobre el perfil. Usando el ADCP y GPS se pueden obtener estimaciones de las velocidades y disipación del oleaje a través del arrecife. Con todos los estimadores, el arrecife posterior resultó ser el más rugoso, lo cual tiene fuertes implicaciones en la protección de playas, esto también fue sustentado mediante modelación numérica. La rugosidad del arrecife, la continuidad de la barrera y la proximidad de está a la costa son los principales parámetros que afectan la dinámica de playas. Esta información debe ser considerada en planes de desarrollo costero cuando hay sistemas arrecifales implicados.

Keywords: Coral-Reefs Roughness Bathymetry Wavelets

CALCIFICATION OF LARVAE OF *STROMBUS (L.) GIGAS* IN THE CARIBBEAN.

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Monthly from July to September, five sites of the Greater Caribbean were sampled in Puerto Morelos, Florida, Dominican Republic, Guadeloupe and Barbados. The aim of this study was to analyze the larval calcification of *Strombus (Lobatus) gigas* throught the Caribbean. From the NOAA were taken daily data average of temperatures (° C), salinity (UPS), dissolved oxygen (mg l-1), chlorophyll concentration (mg m-3). Larvae of *S. (L.) gigas* were identified and measured (siphonal length µm). ESEM-Philips XL30 Scanning Electron Microscope was used for calcium analysis). Average siphonal length of larvae analysed was 421.35 ± 143.09 µm. The Calcium average was 12.75 ± 8.21 (n= 51 larvae). The highest percentage was registered in the Dominican Republic and Barbados (16.67 ± 13.09% and 13.69 ± 6.84%, respectively). These larvae showed a sifonal length of 380.77 µm and 336 µm, respectively. The lowest calcium percentage was registered in Guadeloupe (6.74 ± 0.0% and length 664 ± 0.0 µm). Larvae sampled in July showed the highest calcium percentage (13.03 ± 8.57%) and the lowest was observed in August with 9.8 ± 4.24. No significant difference was found among sites (KW, n = 51, g.l.4, H 4.19, p 0.3809) and months (KW, g.l.2, H 0.59, p 0.7437).

Mensualmente de julio a septiembre, cinco sitios en el Gran Caribe fueron muestrados: Puerto Morelos, Florida, República Dominicana, Guadalupe y Barbados. El objetivo de este estudio fue analizar la calcificación en larvas de Strombus (Lobatus) gigas a través del Caribe. De la Base de datos de la NOAA se obtuvieron los promedios diarios de temperatura (° C), salinidad (UPS), oxígeno disuelto (mg l-1), concentración de clorofila (mg m-3). Las larvas de S. (L.) gigas fueron identificadas y medida (longitud sifonal µm). Se utilizó un Microscopio Electrónico de Scaneo SEM-Philips XL30 para el análisis de Calcio. La longitud sifonal promedio de las larvas analizadas fue 421.35 ± 143.09 µm. El porcentaje de Calcio fue 12.75 ± 8.21 (n= 51 larvae). Los porcentajes más altos se registraron en la República Dominicana y en Barbados (16.67 ± 13.09% y 13.69 ± 6.84%, respectivamente). Estas larvas registraron una longitud sifonal de 380.77 µm y 336 µm, respectivamente. El porcentaje de Calcio más bajo se registró en Guadalupe (6.74 ± 0.0% y longitud sifonal 664 ± 0.0 µm). Las larvas muestreadas en julio registraron el porcentaje más alto de Calcio (13.03 ± 8.57%) y el más bajo fue observado en agosto (9.8 ± 4.24). No se encontró diferencia significativa entre sitios (KW, n = 51, g.l.4, H 4.19, p 0.3809) ni entre meses (KW, g.l.2, H 0.59, p 0.7437).

Keywords: Calcificación, *Strombus (L.) gigas*, Caribe

TWENTY-TWO YEARS OF SEAGRASS MONITORING AT THE PUERTO MORELOS CARICOMP SITE: DISCERNING NATURAL AND HUMAN-INDUCED CHANGES

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During the summer and winter from 1993 to 2015, the community structure of the seagrass beds and foliar dynamics of the dominant seagrass *Thalassia testudinum* were determined at four sites in the Puerto Morelos reef lagoon, Mexican Caribbean following the CARICOMP protocol. Interannual fluctuations in parameters of the community and foliar dynamics of *T. testudinum* could not be associated with naturally occurring events, such as heavy rains or high temperature periods. Patterns of change were gradual, with significant increase in total above-ground biomass of *Syringodium filiforme* and fleshy algae. *T. testudinum* and *S. filiforme* invested proportionally more biomass in above-ground leaf tissues. Three minor hurricanes had no detectable impacts on seagrass beds, but Wilma (October 2005) changed the community composition at three stations and buried completely the coastal station. It is probably that gradual changes in the seagrass community recorded in 22 years of monitoring in the CARICOMP site reflect the increased pollution caused by the rapid increase in urban and tourism developments in Puerto Morelos, coupled with poor water management services.

Keywords: seagrass, *Thalassia*, environmental monitoring, eutrophication

THE POTENTIAL FOR NON-SCLERACTINIAN HOSTS TO ACT AS *SYMBIODINIUM* RESERVOIRS

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Symbiont type is important in enabling hosts to partially mitigate the detrimental effects of global climate change. Spatial variations in *Symbiodinium* communities available to hosts could have implications for the ability of reef communities to respond to environmental stressors. However, little is known about how symbioses with non-scleractinians (i.e. gorgonians, octocorals etc.) are distributed over large spatial scales, and how these assemblages contribute to this environmental pool. Using a meta-analysis approach, we assessed the pan-Caribbean diversity of *Symbiodinium* associated with scleractinian and non-scleractinian hosts. Although scleractinian associated *Symbiodinium* assemblages exhibit biogeographic partitioning, non-scleractinian associated *Symbiodinium* assemblages are largely spatially consistent across the Caribbean. This divergence in distribution as well as evidence of shared symbiont diversity between host types suggests that non-scleractinian hosts may act as a reservoir of *Symbiodinium* diversity across the Caribbean, and the availability and diversity of these reservoirs is driven by the distributions of these hosts.

El tipo de simbionte puede permitir a su huésped mitigar parcialmente los efectos perjudiciales del cambio climático. Las variaciones espaciales en comunidades de Symbiodinium podrían afectar la capacidad de los arrecifes para responder a factores de estrés ambiental. Sin embargo, existe poca información sobre la distribución de las asociaciones de Symbiodinium con organismos no-escleractínidos (e.g. gorgonias, octocorales etc.) sobre grandes escalas espaciales, y la contribución de estas comunidades a la reserva ambiental. Evaluamos por medio de técnicas de meta-análisis, la diversidad pan-Caribeña del Symbiodinium asociado a huéspedes escleractínidos y no-escleractínidos del arrecife, además de otros tipos de vida libre. Aunque las agrupaciones de Symbiodinium y coral escleractínido exhiben una división biogeográfica, en su mayoría, la distribución de las asociaciones de Symbiodinium con otros huéspedes es consistente a lo largo de la región. Esta divergencia en distribución, junto con la evidencia de la diversidad compartida del simbionte entre distintos tipos de huésped, sugiere que los organismos no-escleractínidos podrían servir como una reserva de diversidad de Symbiodinium en el Caribe, y la disponibilidad y la diversidad de estas reservas son determinadas por la distribución del organismo huésped.

Keywords: *Symbiodinium*, biogeography, meta-analysis, reservoir, Caribbean, community

FINDING THE NEEDLE IN THE HAY STACK. USE OF THE CNIDARIAN MODEL SYSTEM, *EXAIPTASIA PALLIDA* TO SCREEN POTENTIAL DISEASE CAUSING PATHOGENS IN CORALS

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Caribbean coral reefs are rapidly declining due partially to increased disease outbreaks. One of the major diseases effecting scleractinian corals is White Plague Disease (WPD). In the late 90s, the causative agent for WPD was demonstrated to be *Aurantimonas coralicida* however, this pathogen has no longer been associated with later re-appearances of similar signs of WPD affecting corals along the Florida Reef Tract. There is a current urgency to discover the causative agent of this disease so that remediation plans can be designed to treat diseased corals in future outbreaks. This study used the sea anemone, *Exaiptasia pallida* to test pathogenicity of bacterial isolates derived from WPD lesions. The use of the sea anemone model allowed for rapid screening of potential pathogens and narrowed down candidate causative agents that could be tested on coral samples. A total to 33 bacterial isolates were tested on *E. pallida* at a final bacterial concentration of 10^8, 10^7, and 10^6 CFU/ml. Challenge experiments occurred over 5 days at 30˚C in triplicate. Out of the 33 isolates, 11 bacterial strains did not cause anemone mortality regardless of bacterial inoculation concentration. Twenty two bacterial isolates caused mortality at different rates at 10^8 CFU/ml. Three isolates caused 100% mortality after 48 hours from the inoculation. Six additional bacterial isolates caused 100% mortality after longer periods of exposure (72 -120 hours). The varied response of *E. pallida* to different bacterial strains suggests that some strains are more pathogenic than others. We showed that this sea anemone is a cost-effective surrogate to pre-screen microbial agents to identifying potential pathogens affecting corals. Thus, the use of coral material for microbiological testing is considerably reduced. In the future, the most virulent isolates will be tested on coral samples to determine which challenges recreate the signs of WPD.

Keywords: Coral Disease, White Plague Disease, *Exaiptasia pallida*, corals, microbiology, bacterial pathogen screening

POTENTIAL IMPACTS OF CLIMATE CHANGE IN REPRODUCTIVE PHENOLOGY OF ECONOMICALLY IMPORTANT FISHES FROM SOUTHERN GULF OF MEXICO.

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Increments in sea temperature and dissolved carbon dioxide concentrations (CO2), changes in circulation patterns of marine currents and the occurrence of extreme meteorological conditions are principal climate change outcomes affecting marine fish populations. These disturbances may be the result of alterations produced in individual, population or even ecosystem levels. Water temperature is one fundamental physical factor that controls phenological events in fishes such as reproduction and early life stages development. Increments in temperature alter the endocrine system and induce stress, and thus inhibiting sex steroids production. As a consequence, overall reproduction may be suspended and sexual cycle, sexual determination and sexual transition (for sequential hermaphroditic species) affected. Potentially serious consequences of temperature and CO2 rising are that they can affect embryonic and larval development, and moreover, impairment of olfactory sensitivity and changes in behavior of larval fish. In southern Gulf of Mexico, in the continental platform surrounding the Yucatan Peninsula (Campeche Bank), groupers (Epinephelidae, Epinephelini), snappers (Lutjanidae) and wrasses (Labridae) are heavily exploited as one of the most important fishery resources in Mexico. These fishes drift during its life cycle from a three-dimensional pelagic realm (embryos and larvae) to a two-dimensional demersal one (juveniles and adults). Therefore they are more sensitive to clime change outcomes that could display different effects according to their type of sexuality, reproductive seasonality, spawning behavior and connectivity between essential habitats. Consequently, climate change may be an additional threat to the already overexploited populations.

El incremento de la temperatura y del dióxido de carbono (CO2) disuelto en los océanos, la alteración de los patrones de circulación de las corrientes marinas, así como la ocurrencia de eventos meteorológicos extremos son las principales consecuencias del cambio climático que afectan las poblaciones de peces marinos. Los efectos pueden manifetarse como perturbaciones al nivel del individuo, de la población o del ecosistema. La temperatura es un factor físico fundamental que regula los eventos fenológicos relacionados con los procesos de reproducción y de desarrollo temprano de los peces. El incremento de temperatura afecta directamente al sistema endocrino de los organismos e induce un estado de estrés en los individuos, provocando una disminución en la producción de esteroides sexuales. Como consecuencias la reproducción puede detenerse y el ciclo sexual, los procesos de determinación sexual y de inversión sexual (caso de especies hermafroditas sucesivas) pueden ser afectados. Las

temperaturas elevadas afectan también el desarrollo embrionario y larvario y los valores elevados de presión parcial en CO2 producen una deterioración de la sensibilidad olfativa y un cambio de comportamiento de las larvas. En el sur del Golfo de México, sobre la extensa plataforma continental de la Península de Yucatán (Banco de Campeche), los meros (Epinephelidae, Epinephelini), pargos (Lutjanidae) y doncellas (Labridae) constituyen uno de los recursos pesqueros más importantes para México. Estas especies cuyos individuos transitan durante su ciclo de vida de un ambiente pelágico tridimensional (fases embrionaria y larvaria) a uno demersal bidimensional (fases juvenil y adulta), pueden ser afectadas de diversas maneras por los efectos del cambio climático según el tipo de sexualidad que exhiben, la estación del año durante la cual se reproducen, el comportamiento de desove que presentan y el nivel de conectividad requerido entre sus hábitats esenciales. Aunado a la pesca, el cambio climático puede entonces constituir un factor suplementario que altere la producción pesquera, en particular cuando las especies ya se encuentran sobreexplotadas.

Keywords: Global warming, reproduction, teleosts, fisheries

HARMONIZING MARINE AND TERRESTRIAL PALEOCLIMATE ARCHIVES TO BETTER UNDERSTAND CARIBBEAN CLIMATE DYNAMICS

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In the Caribbean, attribution of climatic change to both natural and anthropogenic causes is hampered by short and fragmented meteorological records which do not capture longer-term natural climate variability. To address the need for longer climate records, paleo-environmental scientists extend the instrumental climate record back in time using proxy-based data recovered from natural marine and terrestrial archives. However, comparisons between natural archives are often complicated by differences in accumulation rates and temporal resolution, and also in the methods used to date the archives. In order to improve our understanding of the ocean-atmosphere interactions in the Caribbean, we applied simple statistical techniques to harmonize the chronology of coral-based sea surface temperature record from the Western Caribbean and a mangrove-lagoon sediment archive from Jamaica. Subsequent comparisons between coral-based reconstructions of SST and lake level change, and meteorological records of hurricane activity, revealed statistically significant relationships between these variables for the period AD 1773-2008. Given these relationships, we developed a sediment-based, hurricane activity index, which suggested that hurricane activity likely increased in the Western Caribbean during periods of low natural radiative forcing and decreased during the warmer mean climate states of the last millennium. A gradual increase in Atlantic hurricane activity during the industrial period (ca. 1870-present) is probably a response to a combination of natural- and human-induced forcing factors. Thus, the ability to better constrain the lower-resolution chronologies that characterize mangrove lagoon sediments with their high-resolution coral counterparts, provides new research opportunities to improve our understanding of the nature and timing of the different climate cycles recorded within the Caribbean paleoclimate archives.

Keywords: Caribbean, Paleoclimate, Coral, Mangrove lagoon, SST, Hurricanes

UPDATE ON REEF REPLENISHMENT EFFORTS IN BELIZE: SUCCESS INDICATORS AND EXPANSION PLANS

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Coral restoration efforts have been ongoing in Belize for over a decade now. Results from acroporid restoration work at Laughing Bird Caye National Park, Belize are shared here, where over 70,000 nursery-grown acroporid fragments have been out-planted in ~ one hectare of degraded reef in an effort to conserve biodiversity and restore tourism value to this popular and heavily visited site. Success indicators include longevity, genetic diversity, bleaching resilience, reproductive indicators, increases of live acroporid cover from zero to over 35%, changes in fish biomass on out-planted sites, and direct local community engagement via a training course vetted by the Belize Fisheries Department. Updates include expansion efforts to South Silk and Moho Caye in southern Belize (over 10,000 corals outplanted at each caye), and new nurseries installed in South Water Caye Marine Reserve (four) and Turneffe Atoll Marine Reserve (three). Additional updates include methods to assess micro-scale biodiversity by deploying Autonomous Reef Monitoring Structures (ARMS), and new techniques for micro-fragmenting 'slower growing' species such as star, brain and pillar corals. These two methods have been used elsewhere, but are modified for use in Belize. The ARMS units, developed by Dr. Nancy Knowlton, will compare biodiversity in replenished and un-replenished sites, both inside and outside of MPAs, on shallow fringing reefs. The micro-fragmenting technique (developed Mote Marine Laboratory) was modified for in situ execution (no initial period in aquariums or tanks). Micro-fragmentation is effective for massive as well as branching corals so if successful, this method could revolutionize reef replenishment efforts in Belize and the Caribbean that have traditionally focused primarily on the faster growing acroporids.

Los esfuerzos de restauración de corales han estado en curso en Belice desde hace más de una década. Aquí se comparten los resultados de los trabajos de restauración acroporidos en el Parque Nacional de Laughing Bird Caye, Belice, donde se han sembrado más de 70.000 fragmentos acroporidos en una hectárea de arrecife degradado en un esfuerzo por conservar la biodiversidad y restablecer el valor turístico de este popular Y sitio muy visitado. Los indicadores de éxito incluyen la longevidad, la diversidad genética, la resiliencia del blanqueo, los indicadores reproductivos, el aumento de la cobertura acroporida en vivo de cero a más del 35%, los cambios en la biomasa de peces en los sitios sembrados y el compromiso directo de la comunidad local mediante un curso de capacitación aprobado por Belize Fisheries Departamento. Las actualizaciones incluyen esfuerzos de expansión a South Silk y Moho Caye en el sur de Belice (más de 10.000 corales plantados en cada cayo), y nuevos viveros instalados en la Reserva Marina South Water Caye (cuatro) y Turnoffe Atoll Marine Reserve (tres). Actualizaciones adicionales incluyen métodos para evaluar la biodiversidad a microescala mediante la implementación de estructuras de monitoreo de arrecifes autónomos (ARMS), y nuevas técnicas para micro-fragmentar especies de 'crecimiento lento' como corales estrella, cerebro y pilar. Estos dos métodos se han utilizado en otros lugares, pero se han

modificado para su uso en Belice. Las unidades ARMS, desarrolladas por la Dra. Nancy Knowlton, compararán la biodiversidad en sitios repoblados y no regenerados, tanto dentro como fuera de las AMPs, en arrecifes de franjas poco profundas. La técnica de micro-fragmentación (desarrollada Mote Marine Laboratory) se modificó para la ejecución in situ (sin período inicial en acuarios o tanques). La microfragmentación es efectiva tanto para los corales masivos como para los ramificados, por lo que si tiene éxito, este método podría revolucionar los esfuerzos de reposición de arrecifes en Belice y el Caribe, que tradicionalmente se han enfocado principalmente en los acroporidos de mayor crecimiento.

Keywords: Caribbean reef restoration, success indicators, biodiversity

DIFFERENTIAL PHOSPHORYLATION OF A HSP-LIKE PROTEIN FROM CULTURED *SYMBIODINIUM* UNDER VARIOUS LIGHT CONDITIONS

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Symbiodinium microalgae belong to a genus of photosynthetic dinoflagellates that usually live as endosymbionts in marine invertebrates such as anemones, jellyfish and corals. However, they are also able to live independently outside their host as planktonic organisms. Due to their photosynthetic ability, they are sensitive to changing light conditions in the marine environment. Thus, light-sensing mechanisms are of utmost importance in responding to environmental changes in these organisms. We have identified a HSP-like protein from cultured *Symbiodinium microadriaticum* with a mass of ~75 kDa which is phosphorylated on threonine after 12 hours of continuous darkness. The original level of phosphorylation decreased when the *Symbiodinium* cells were exposed to light for about 30 min, regardless of the intensity. Upon exposure to different types of light, we observed a lower effect on the level of dephosphorylation by exposure to blue light compared to red. In addition, we examined the effect on dephosphorylation of the protein upon light exposure after incubating the cells at 26, 32 and 36°C. Interestingly, light-induced dephosphorylation was only detected at 26°C and no changes in phosphorylation levels at the higher temperatures of 32 or 36°C were observed. Finally, 2D-PAGE analysis revealed that this protein displays two isoforms likely due to differential phosphorylation. We are currently focusing on raising antibodies to this protein to study its changes in expression and compare them to changes in the level of phosphorylation under different light conditions. This will also allow us to determine its subcellular localization and identification of associated ligands. These studies will bring knowledge on the specific function of this protein in the *Symbiodinium* light-induced responses.

Las microalgas de *Symbiodinium* pertenecen a un género de dinoflagelados fotosintéticos que habitualmente viven como endosimbiontes dentro de invertebrados marinos tales como anémonas, medusas y corales. Sin embargo, también son capaces de vivir independientemente fuera del huésped como organismos planctónicos. Debido a su capacidad fotosintética son sensibles a las condiciones cambiantes de luz del medio ambiente marino. Por ello, los mecanismos de detección de luz son de suma importancia para responder a los cambios medioambientales en estos organismos. Hemos identificado una proteína tipo HSP de *Symbiodinium microadriaticum* en cultivo con un peso de ~ 75 kDa que está fosforilada en treonina después de 12 horas de oscuridad continua. El nivel original de fosforilación disminuyó cuando las células de Symbiodinium fueron expuestas a la luz durante 30 min, independientemente de la intensidad lumínica. Tras la exposición a diferentes tipos de luz, se observó un menor efecto en el nivel de desfosforilación con luz azul que con roja. Adicionalmente, examinamos el efecto en la desfosforilación de la proteína tras la exposición a la luz, después de incubar las células a 26, 32 y 36°C. Interesantemente, la desfosforilación inducidad por luz solamente se

detectó a 26°C y no se observaron cambios en los niveles de fosforilación a las temperaturas mayores de 32 o 36°C. Por último, análisis en geles de 2D-PAGE revelaron dos isoformas de la proteína, probablemente debidas a una fosforilación diferencial. Actualmente nos estamos enfocando en la obtención de anticuerpos específicos para esta proteína que nos permitirán estudiar los cambios de expresión y compararlos con los cambios del nivel de fosforilación bajo diferentes condiciones de luz. Los anticuerpos también nos permitirán determinar su localización subcelular e identificar ligandos asociados. Estos estudios arrojarán conocimiento importante sobre la función específica de esta proteína en las respuestas inducidas por luz de *Symbiodinium*.

Keywords: Heat Shock Protein, light response, phosphorylation, *Symbiodinium*, temperature effect

COST-BENEFIT ANALYSIS OF RESTOCKING STAGHORN CORAL (*ACROPORA CERVICORNIS*) POPULATIONS ON THE FLORIDA REEF

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Staghorn coral (*Acropora cervicornis*) populations have experienced extreme declines in the SE Atlantic/Caribbean over the last four decades. Evidence suggests restocking depleted staghorn populations with nursery propagated colonies may increase the likelihood of long-term species recovery. Implementing marine reserves to protect restored coral reefs may improve the chances of survival for outplanted staghorn colonies and recruitment of new colonies. A greater understanding of the ecological dynamics and economics of coral reef restoration is required, as is consideration of alternative management options, to determine whether, and under what conditions, large scale coral reef restoration and protection are effective uses of available resources. This research will employ an Ecosystem Services (ES) framework to estimate the Return on Investment (ROI) from restocking and protecting staghorn coral populations off Florida. The study will consider four important coral reef associated ES, namely support of commercial fisheries, support of recreational opportunities, support of cultural, religious, or spiritual values, and coastal storm protection. To examine the commercial fishery value of reef restoration and protection, we develop a bioeconomic model that simulates changes in the long-run equilibrium of reef-supported harvestable fish stocks and optimal annual harvesting rates under alternative restocking and protection regimes. Public preferences for restocking and protecting staghorn populations along the Florida Reef will be elicited and people's willingness-to-pay (WTP) for enhanced staghorn associated ES will be estimated through a web-based Discrete Choice Experiment (DCE). Aggregating these values will enable estimation of the incremental and Total Economic Value (TEV) of restocking staghorn corals. This general valuation framework linking coral protection and fisheries ecosystem services will provide policy and decision makers with straightforward metrics to evaluate alternative recovery actions.

Las poblaciones de coral cuerno de ciervo (*Acropora cervicornis*) han experimentado disminuciones extremas en el Atlántico sureste / Caribe durante las últimas cuatro décadas. La evidencia sugiere que la repoblación de poblaciones de coral cuerno de ciervo agotadas con colonias propagadas en vivero puede aumentar la probabilidad de recuperación a largo plazo de especies. La implementación de reservas marinas para proteger los arrecifes de coral restaurados puede mejorar las posibilidades de supervivencia de las colonias de staghorn plantadas y el reclutamiento de nuevas colonias. Se requiere una mayor comprensión de la dinámica ecológica y económica de la restauración de los arrecifes de coral, así como la consideración de alternativas de manejo para determinar si, y bajo qué condiciones, la restauración y protección de arrecifes de coral a gran escala son usos efectivos de los recursos disponibles. Esta investigación empleará un marco de Servicios de Ecosistemas (SE) para estimar el Retorno de la Inversión (RI) de la repoblación y protección de las poblaciones de corales cuerno de ciervo fuera de la Florida. El estudio considerará cuatro importantes SE relacionados con

los arrecifes de coral, a saber, el apoyo a las pesquerías comerciales, el apoyo a las oportunidades recreativas, el apoyo a los valores culturales, religiosos o espirituales y la protección contra las tormentas costeras. Para examinar el valor de la pesquería comercial de la restauración y protección de los arrecifes, desarrollamos un modelo bioeconómico que simula cambios en el equilibrio a largo plazo de las poblaciones de peces cosechables respaldadas por arrecifes y tasas óptimas de cosecha anual bajo regímenes alternativos de repoblación y protección. Se obtendrán las preferencias públicas para el repoblamiento y protección de las poblaciones de estafilocales a lo largo del arrecife de Florida, y se estimará la disposición de las personas a pagar para SE mejorado. La agregación de estos valores permitirá estimar el incremento y el valor económico total de la repoblación de corales cuerno de ciervo. Este marco general de valoración que vincula la protección de los corales y los servicios ecosistémicos de las pesquerías proporcionará a los responsables de las políticas ya los encargados de la adopción de decisiones indicadores sencillos para evaluar las acciones alternativas de recuperación.

Keywords: Staghorn, Cost-Benefit, Cervicornis, Restoration, Discrete-Choice Experiment

SEASONAL RECRUITMENT AND SURVIVAL STRATEGIES OF *PALISADA CERVICORNIS COMB*. NOV. (CERAMIALES, RHODOPHYTA) IN CORAL REEFS

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As marine tropical ecosystems deteriorate and lose biodiversity, their communities are shifting to dominance of few species, altering ecosystem's functioning and services. Macroalgae are a group of species that are becoming dominant on coral reefs and are frequently found overgrowing and outcompeting corals. Turf algal assemblages are the base of energy flow in the system and one of the most abundant types of macroalgae on coral reefs, but little is known about their biology and diversity. Through a molecular and morphological study, we established the proper identity of the turf forming species *Laurencia cervicornis*, and by studying seasonal recruitment and the impact of herbivorous fishes on its abundance, we describe its survival strategy. The molecular analysis using a total of 45 rbcL sequences including eight current genera of the *Laurencia* complex and two newly sequences of *L. cervicornis*, strongly support its nomenclature status adjustment to *Palisada cervicornis comb*. nov. , and a detailed morphological description of the species, including the description of reproductive structures is provided. *P. cervicornis* was found recruiting in all seasons but was typically in low abundance. Specimens, grown in tiles on fish exclosure cages, were devoured in less than 4 hours when offered to fishes. Even though many species of the *Laurencia* complex have chemicals that deter herbivory, species of the genus *Palisada* lack feeding deterrents and are highly palatable. Based on our results, we suggest that P. cervicornis finds refuge in turf assemblages, where it is continually cropped by herbivores but not completely consumed.

A medida que los ecosistemas tropicales marinos se deterioran y pierden biodiversidad, sus comunidades están siendo dominadas por pocas especies, alterando el funcionamiento y los servicios del ecosistema. Las macroalgas son un grupo de especies que se están convirtiendo en dominantes en los arrecifes de coral y con frecuencia se encuentran desplazan los corales. Los conjuntos de algas formadoras de césped son la base del flujo de energía en el sistema y uno de los tipos más abundantes de macroalgas en los arrecifes de coral, pero poco se sabe sobre su biología y diversidad. A través de un estudio molecular y morfológico, establecimos la identidad taxonómica de la especie formadora de césped *Laurencia cervicornis*, y estudiando el reclutamiento estacional y el impacto de los peces herbívoros sobre su abundancia, describimos su estrategia de supervivencia. El análisis molecular utilizando un total de 45 secuencias de rbcL incluyendo ocho géneros actuales del complejo *Laurencia* y dos nuevas secuencias de *L. cervicornis*, apoyan fuertemente su ajuste nomenclatural a *Palisada cervicornis comb*. nov., además se proporciona una descripción morfológica detallada de la especie, incluyendo la descripción de las estructuras reproductivas. Reclutas de *P. cervicornis* fueron encontradas en todas las estaciones, pero con abundancia baja. Los especímenes crecidos

en placas de reclutamiento dentro de jaulas para evitar ser consumidos, fueron devorados en menos de 4 horas cuando fueron ofrecidos a los peces. A pesar de que muchas especies del complejo Laurencia tienen productos químicos que disuaden la herbivoría, las especies del género Palisada carecen de estos compuestos y son altamente consumidas. Basándonos en nuestros resultados, sugerimos que P. cervicornis encuentra refugio en las asociaciones de céspedes, donde es continuamente recortada por herbívoros, pero no completamente consumida.

Keywords: Algal recruitment, herbivory, *Palisada cervicornis*, rbcL, taxonomy, turf algae.

THERMOHALINE DYNAMICS AND THE EFFECT OF EXTREME SALINITY GRADIENTS IN THE ICHTHYOFAUNA DISTRIBUTION IN A TROPICAL COASTAL LAGOON

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The coastal lagoon La Carbonera has important submarine groundwater discharges (SGD) and wide salinity ranges, which modify fish distribution. The hydrodynamics were studied through observations and numerical modeling. Five CTD sensors moored at strategic sites gathered temperature, salinity, and water level variations from September 2014 to September 2015. The Delft3D numerical model was implemented to assess the effect of wind, tides, temperature, and salinity and SGD in the currents and thermohaline fields. Salinity was related with the distribution of stenohaline ichthyofauna from an existing database of fish distribution (monthly data from 2009 to 2011 in 12 stations). The lagoon has 4 regions: hyperhaline (> 80, east), marine region (mouth), estuarine (west) and fresh (submarine spring). Currents are higher the west and central regions (dominated by tides which drive the advection of seawater and freshwater at the different tidal stages). The eastern region has low-magnitude currents and little water exchange. The saline fields change through the tidal cycle with larger fresh water excursion to the sea during low tides. During Northerly wind events, seawater reaches further into the wetland towards the south and east of the lagoon. During the dry season extremely high salinity values (>80) were recorded in the eastern side, which are diluted as the first rain events appear. Changes in salinity gradients may alter the distribution range of fish. Estuarine species (*Menidia colei*, *Sphyraena barracuda a*nd *Archosargus rhomboidalis*) have been observed in the southeast zone (marine and hipersaline) during Northerly storms. Freshwater species (*Gambusia yucatana*) are present in the estuarine zone. Events of seawater intrusion were observed at the spring mooring site and serve to explain the presence of marine species (*Paralichthys albigutta*) in the freshwater region. The daily and yearly variations of the currents and salinity fields determine the spatial distribution of stenohaline species of this lagoon system.

La laguna costera La Carbonera posee una importante descarga de aguas subterráneas y amplios rangos de salinidad, lo cual modifica la distribución de los peces. La hidrodinámica fue estudiada a través de observaciones y modelación numérica. Cinco sensores CTD ubicados en lugares estratégicos registraron temperatura, salinidad y variaciones del nivel del agua desde septiembre 2014 a septiembre 2015. El modelo numérico Delft3D fue implementado para evaluar el efecto del viento, mareas, temperatura, salinidad y descargas de agua subterráneas en las corrientes y patrones termohalinos. La salinidad fue relacionada con la distribución de la ictiofauna estenohalina a través de una base de datos de distribución de peces ya existente (datos

tomados mensualmente de 2009 a 2011 en 12 estaciones). La laguna presenta 4 regiones: hiperhalina (>80, este), región marina(bocana), estuarina (oeste) y agua dulce (descargas subterráneas). Las corrientes son mayores en las regiones centrales y oeste (influenciadas por las mareas, las cuales provocan la advección del agua marina y dulce en las diferentes fases mareales). La región este posee corrientes de baja magnitud y escaso intercambio de agua. Los patrones de salinidad cambian a través de los ciclos de marea, existiendo una mayor descarga de agua dulce hacia el mar durante las bajamares. Durante los eventos de vientos del Norte, el agua de mar alcanza sus mayores cotas hacia las zonas sur y este de la laguna. Durante la época de sequía se obtuvieron valores extremadamente altos de salinidad en la zona este de la laguna, los cuales disminuyeron al caer las primeras lluvias. Los cambios en los gradientes salinos afectan los ámbitos de distribución de los peces. Especies estuarinas (*Menidia colei, Sphyraena barracuda* y *Archosargus rhomboidalis*) fueron observadas en la zona sureste (marina e hiperhalina) durante las tormentas de componente norte. Las especies dulceacuícolas (*Gambusia yucatana*) están presentes en la zona estuarina. Fueron observados eventos de intrusión de agua marina en la zona de descarga de agua subterránea, lo cual sirve para explicar la presencia de especies marinas (*Paralichthys albigutta*) en la región de agua dulce. Las variaciones diarias y anuales de las corrientes y los patrones salinos determinan la distribución de las especies estenohalinas de este sistema lagunar.

Keywords: hydrodynamics, salinity, ichthyofauna, SGD

OBSERVER EFFECTS AND CALIBRATION IN UNDERWATER VISUAL SURVEYS OF FISH: A MULTIVARIATE APPROACH.

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Visual census is the main method used to assess coral reefs fish abundances. Independent of the method used, the effect of the observer on accuracy and precision is important. At a minimum, these effects increase the error term of quantitative analyses, which reduces statistical power. At worse, observer bias could cause serious problems affecting conclusions, a problem further exacerbated when considering studies of large spatiotemporal scales, where different surveyors do different locations/regions and/or different year/times. To minimize this issue, different training programs are recommended, coupled with calibration methods to estimate inter-observer variation. Most approaches to this calibration assume that perfect accuracy (i.e., identical estimates done by different but equally skilled surveyors) is impractical, and consequently, they focus on estimating inter-observer precision. They also typically used univariate estimates, such as total biomass, total number of species, abundance of the most important species, etc.; few have attempted to use the information contained in the entire data matrix (i.e., all biomass/abundances of all species present in the sampled assemblage). Here, we propose a calibration approach using a multivariate measure of dispersion (i.e. average distance of samples to the centroid). To test this, we performed a typical training/calibration protocol for fish surveys in the west coast of Puerto Rico, which consisted in repeated sampling (15 times) of two very well-known locations by 6 divers (2 experienced, 2 trained and 2 unexperienced fish surveyors). Our multivariate approach coupled with standard univariate estimators of precision showed that some of the biases normally encountered using univariate estimators only (e.g., different conclusions are reached using different species) were overcome by considering the entire sampled fish assemblage. We suggest that, when doing visual fish surveys, the use of multivariate estimators of dispersion, in addition to the univariate estimators, would improve overall interpretation of the observer effect.

Keywords: Fish assemblages, Surveys, Calibration, Monitoring

ULTRASTRUCTURAL AND MOLECULAR CHARACTERIZATION OF DIGESTIVE GLAND INCLUSIONS IN THE QUEEN CONCH (*LOBATUS GIGAS*)

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In St. Kitts, Lesser Antilles, queen conch (*Lobatus gigas*) invariably show large numbers of unusual, intracytoplasmic inclusions in epithelial cells of the digestive gland. Previous studies described these inclusions as apicomplexan parasites, and they are reportedly ubiquitous across the Caribbean region, and even suspected to cause mortality or reproductive failure. However, in our survey the digestive gland showed no features to indicate a response to injury, as would be expected with an infectious process. Furthermore, it is exceptionally rare for an infection to have 100% prevalence. Thus, we hypothesized that the inclusions were not infectious organisms. The aim of this study was to describe their composition using ultrastructural and molecular techniques. Histologically, the inclusions start as 2-4um, blue-purple to brown spherical granules and transition to 10x30um elongate ovoid to tri-bulbous dark brown inclusions. Some were found within the lumen of digestive gland ducts and the gastrointestinal tract. The brown pigment in the large inclusions stained with Fontanna Masson and was removed with melanin bleach. The rims of the large inclusions stained with Alcian blue (pH 2.5). The inclusions were also stained with Periodic Acid Schiff and Perls Iron stain. When examined with transmission electron microscopy, the inclusions consisted of electron-dense, variably compact lamellated deposits and were devoid of cellular organelles. DNA extractions of purified concretions did not yield sufficient concentrations for successful PCR amplification. When examined by scanning electron microscopy with energy dispersive x-ray analysis, the inclusions contained a number of elements, particularly iron. We conclude that these inclusions are not an infectious agent, and hypothesize that they are an iron storage-complex, potentially including other elements and a glycoprotein matrix. Similar structures have been described in the digestive glands of other invertebrates, including prosobranchs.

Keywords: pathology, conch, disease, histology, parasitology

MACROSCOPIC PATHOLOGY OF *ORBICELLA ANNULARIS* AND *O. FAVEOLATA* IN ST. KITTS

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The *Orbicella annularis* complex (*O. annularis*, *O. faveolata* and *O. franksi*) is an important framework group of corals on western Atlantic reefs. It comprises around 15% of all scleractinian corals in St. Kitts and Nevis. There are no detailed reports on the health status of the *O. annularis* complex around St. Kitts, particularly in shallow coastal areas where some of the largest colonies are found. The objective of this study was to systematically describe and categorize the macroscopic pathology and progression of lesions observed in *Orbicella* colonies in St. Kitts. We identified and tagged colonies of *O. annularis* (n=19) and *O. faveolata* (n=29) showing macroscopic lesions on 7 different shallow coastal reefs off St. Kitts. The lesions were categorized according to gross morphology including focal chronic tissue loss with marginal brown or yellow pigmentation, occasionally accompanied by a bleached band (n=36), focal brown pigmentation +/- intra-lesion foci of chronic tissue loss (n=18), focal to diffuse bleaching (n=13), and other (n=4). Tagged corals were monitored over a period of 31 weeks in the autumn/winter using GPS and laminated maps, and were photo-documented every 2 weeks. Tagged corals were monitored over a period of 31 weeks in the autumn/winter using GPS and laminated maps, and were photo-documented every 2 weeks. Based on initial observations, apart from the bleaching group, differences in lesion progression patterns were not evident among lesions groups. Some colonies exhibited tissue loss of up to approximately 1 centimetre per week and others remained visually stagnant or showed regeneration of affected tissue. Bleaching was first observed in October of 2016, when sea temperatures were higher than historical values. They started regaining their normal color by January 2017. Histopathology is presently underway with the aim to more comprehensively diagnose the diseases of St. Kitts' *O. annularis* and *O. faveolata*.

Keywords: pathology, *Orbicella annularis*, *O. faveolata*, macroscopic, disease

NUTRIENT ENRICHMENT SUPPRESSES AN INNATE IMMUNITY PATHWAY IN THE CORAL *PORITES PORITES* AND RECOVERY FROM PREDATION

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Reef-building corals face many threats from not only climate change, but also local stressors such as nutrient pollution. Recent studies show nutrient enrichment increases the negative effects of predation on coral reef communities by facilitating disease and reducing fitness in corals. This suggests the possibility that higher nutrient levels suppress the immune capabilities of corals as well as their capability to respond to microbial infections that follow mechanical injuries due to predation. In this study we measured the effect of nutrient enrichment and grazing on a well-recognized immune defense pathway, the phenoloxidase (PO) pathway involved in melanin synthesis and wound healing. *Porites porites* colonies were exposed in situ to either enriched nutrient levels using controlled release fertilizer containing nitrogen, phosphate, and potassium (19:6:12 of N:P:K) or ambient nutrient levels. Within these two treatments, corals were further exposed to either no damage, mechanical damage, or parrotfish grazing damage. Samples were taken: 1) prior to any damage; 2) after one week of recovery from an initial damage exposure; and 3) after one week of recovery from a repeated damage. The levels of two tyrosinase-type POs as well as one lactase-type PO were measured using enzymatic activity assays on a microplate reader. The two tyrosinase-type POs significantly decreased under nutrient enrichment, suggesting the corals became immuno-compromised under nutrient enrichment. Altogether, this study illustrates the need for the mitigation of nutrient pollution to coral reefs as higher nutrient levels might suppress coral immune capabilities, thereby increasing the susceptibility of corals to disease and subsequent mortality.

Keywords: Coral, nutrients, predation, phenoloxidase, immunity

DOES VARIABILITY IN WATER TEMPERATURE AND DISSOLVED OXYGEN INFLUENCE THE MOVEMENT PATTERNS OF TWO CARIBBEAN FISH?

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Movement plays an important role in an animal's behavior and life history demographics, and is a key component of ecological processes. Measuring and mapping movement patterns for highly mobile fish species may shed light on habitat space-use requirements, behavioral responses to environmental factors and population dynamics. Changes in ambient water conditions (e.g.. temperature, dissolved oxygen, etc.) can influence an individual's physiology and thus movement patterns. While some laboratory studies have examined the effects of environmental factors on fish physiology, few have examined how ambient water conditions affect fish movements in marine habitats. This study investigates the potential influence of water temperature and dissolved oxygen on the movement patterns of Atlantic tarpon (*Megalops atlanticus*) and lane snapper *(Lutjanus synagris*) in Brewer's Bay, St. Thomas, U.S. Virgin Islands. Fifteen fish of each species bearing acoustic transmitters were tracked in an acoustic array and proximal data loggers measured dissolved oxygen and temperature. I expect the movement patterns of lane snapper and tarpon to shift in response to large changes in water condition. Short-term preliminary data from Atlantic tarpon movement in Brewer's Bay suggests that tarpon moves out of its daily activity space when temperatures exceeds above average conditions. This study provides a better insight on which fish species are indicators for environmental variability and thus aiding fisheries managers in making accurate predictions on fish populations.

Keywords: movement, acoustic telemetry, *M.atlanticus, L.synagris*, environmental variability

INFLUENCE OF GLOBAL AND LOCAL STRESSORS ON THE CORAL REEFS NEAR HAVANA, CUBA

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Coral reefs are affected by both local and global stressors. While impact of local stressors such as eutrophication and overfishing have been increasing for at least the past century, intensifications and higher frequency of global stressors, particularly thermal stress events associated with global warming, are a more recent development. Understanding the temporal and spatial scale at which these factors affect coral reefs has serious implications for management and conservation strategies. Here, we combine current surveys and historical data from four coral reef zones located at different distances from long-term major sources of pollution and other anthropogenic activities Havana City, Cuba to investigate the potential importance of local versus global stressors on fish and benthic composition. In May 2016 we assessed nutrient content in algal tissue, depth of deposited sediment layer, benthic composition, fish community structure, and herbivore grazing activity. We found a ubiquitous and historically (since 1970s) high fishing pressure leading to the current low herbivorous fish biomass (12g/m2) across all sites regardless of the distance from Havana City. As a consequence of the poor herbivory pressure (<3bite/0.25m2/min), there was a very high relative abundance of macroalgae (67%) dominated by palatable species. Analysis of historical data (1995-2016) shows that coral cover closer to Havana has been low prior to 1995, probably as a consequence of high eutrophication levels and other local stressors. However, after the 1990s coral cover from Havana city's further and healthier reefs has decreased about 50%, possibly as a consequence of global stressors (e.g. higher frequency of intense bleaching events and Hurricanes). Our results suggest a possible transition from local to global factors shaping benthic communities began in the 1990's. While fish and benthic communities were initially (before 1990s) affected by localized stressors (e.g. eutrophication and overfishing), today overfishing continues to affect all areas while coral community has apparently transitioned to be more greatly affected by global stressors.

Factores locales como la eutroficación y la sobrepesca han estando afectando los arrecifes coralinos por mas de un siglo mientras que el efecto de los factores globales se ha visto mas acentuado en los últimos anos. Por tanto, para poder proponer medidas de manejo y recuperación de estos ecosistemas se hacen necesarios estudios que integren el efecto de estos factores a diferentes escalas temporales y espaciales. Nuestro estudio combina una serie de muestreos recientes y pasados de las comunidades arrecifales localizadas a diferentes distancias de una fuente significativa de contaminación y alta presión pesquera, la Ciudad de la Habana, Cuba, y su relación factores estresantes globales. Nuestros resultados muestran una fuerte presión de pesca a todo lo largo de la zona de estudio desde 1970's que explica la actual baja biomasa de peces herbívoros (12g/m2) y reducida presión de herbivory (<3 mordidas/0.25m2/min). Como consecuencia, la cobertura de macroalgas alcanza niveles muy altos (67%), principalmente de especies comúnmente

consumidas por peces herbívoros. El análisis histórico (1995-2016) de cobertura coralina revela que los arrecifes cerca de la Ciudad Habana han sido fuertemente afectados por factores locales como la eutrofización y sobrepesca desde antes del 1995 (<10%) y no han sufrido cambios desde entonces. Sin embargo, la cobertura de corales en los arrecifes mas alejados de la Ciudad, disminuyo mas de un 50% desde inicios del 2000, posiblemente como resultado del incremento en la frecuencia e intensidad de huracanes y eventos de blanqueamiento. Nuestros resultados indican una posible transición en el nivel de impacto de factores locales y globales. Inicialmente (antes de 1990's), factores como la sobrepesca y eutrofización fueron las principales amenazas de los arrecifes mientras que en la actualidad la combinación de ambos factores, locales y globales parecen estar afectando estos ecosistemas.

Keywords: Coral, Algae, Herbivory, overfishing, eutrophication, Cuba

EFFECTS OF FLORIDA RED TIDES ON HISTONE VARIANT EXPRESSION AND DNA METHYLATION IN THE EASTERN OYSTER *CRASSOSTREA VIRGINICA*

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Massive algal proliferations known as Harmful Algal Blooms (HABs) represent one of the most important threats to coastal areas. Among them, the so-called Florida Red Tides (FRTs, caused by blooms of the dinoflagellate *Karenia brevis* and associated brevetoxins) are particularly detrimental in the southeastern U.S., causing high mortality rates and annual losses in excess of $40 million. The ability of marine organisms to cope with environmental stressors (including those produced during HABs) is influenced by genetic and epigenetic mechanisms, the latter resulting in phenotypic changes caused by heritable modifications in gene expression, without involving changes in the genetic (DNA) sequence. Yet, studies examining cause-effect relationships between environmental stressors, specific epigenetic mechanisms and subsequent responses are still lacking. The present work contributes to increase this knowledge by investigating the effects of Florida Red Tides on two types of mechanisms participating in the epigenetic memory of Eastern oysters: histone variants and DNA methylation. For that purpose, a HAB simulation was conducted in laboratory conditions, exposing oysters to increasing concentrations of *K. brevis*. The obtained results revealed, for the first time, the existence of H2A.X, H2A.Z and macroH2A genes in this organism, encoding histone variants potentially involved in the maintenance of genome integrity during responses to the genotoxic effect of brevetoxins. Additionally, an increase in H2A.X phosphorylation (γH2A.X, a marker of DNA damage) and a decrease in global DNA methylation were observed as the HAB simulation progressed. Overall, the present work provides a basis to better understand how epigenetic mechanisms participate in responses to environmental stress in marine invertebrates, opening new avenues to incorporate environmental epigenetics approaches into management and conservation programs.

Keywords: Epigenetics, Harmful Algal Blooms, Brevetoxins, Oysters, Histone Variants, DNA Methylation

A CARIBBEAN WIDE DISEASE AFFECTING OCEAN SURGEONFISH (*ACANTHURUS BAHIANUS*)

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Disease outbreaks have led to mass mortality of many species resulting in changes that affected most Caribbean coral reef communities. In 2012, many individuals of the surgeon fish *Acanthurus bahianus* in Bonaire had black spots on their bodies and fins. To better understand this newly discovered disease and its implication for coral reefs, three analyses were conducted: a google picture search, in situ fish counts and fish dissections. The google search for pictures of *A. bahianus* discovered that the disease was present since 1985 and is found in many other Caribbean locations. Within the Caribbean, Bonaire was the location with the highest percentage of diseased *A. bahianus*,, making it the ideal location to study this disease. The in situ count of healthy and diseased *A. bahianus* determined that the number of healthy *A. bahianus* increased with depth. On the east side of Bonaire, less than 50% of the fish were diseased, while all sites on the west side of Bonaire had more than 50% diseased individuals. At the site located in front of the main town, Kralendijk, 81.6% of all fish were diseased. Dissections of diseased *A. bahianus* determined that the disease is caused by an encysted parasite, likely a Digenean trematoide (flatworm) in the metacercariae life stage. The parasite was found in the fins and skin tissue of the fish with some cysts damaging the cartilage of the fin ray. Furthermore, a smaller number of bacteria were found in diseased epidermis than in healthy epidermis. No other negative consequences were found, black spot disease will thus unlikely lead to mass mortality of *A. bahianus*. However, due to its visibility, it could possibly serve as a reef health indicator. Therefore, further research should be conducted to identify possible linkages between environmental factors such as pollution and the disease prevalence.

Keywords: Parasite, google picture search, fish counts, disease prevalence, spatial differences, health indicator

ISLAND HOPPING: CORAL REEF FISH PHYLOGEOGRAPHY ACROSS THE CARIBBEAN

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In the Caribbean, there was a long-standing paradigm of coral reef fish populations being open systems – a good deal of migrant exchange. This was supported by population genetic studies. However, in the past 10 years, this paradigm has shifted. It is now recognized that while some species of Caribbean coral reef fishes have little to no genetic structure among populations, some have substantial genetic subdivision throughout their ranges, and some have subtle, but present, population genetic structure. There is no longer a “one size fits all” rule for Caribbean coral reef fish population genetics. In this study, we tested for, and characterized population genetic structure in the Caribbean reef fish *Acanthemblemaria aspera*, the rough head blenny. Populations throughout the Caribbean, as well as the Yucatan were sampled. DNA sequence data was collected for mitochondrial and nuclear genes. These data were analyzed using new Bayesian methods that allow the inference of colonization history across a spherical plane. We used this to construct a model that inferred the place of the original population of *A. aspera* and the species’ dispersal pathways throughout the Caribbean Basin and Gulf of Mexico. In some scenarios, the original population, and the stepping stone populations, were inferred to be at locations where we had not yet collected samples. This has provided us with a framework to guide further collections and extend our work to other Caribbean reef fish species.

En el Caribe, existía el paradigma de que las poblaciones de peces en arrecifes de coral eran sistemas abiertos - una buena cantidad de intercambio de migrantes. Esto fue apoyado por estudios de genética de poblaciones. Sin embargo, en los últimos 10 años, este paradigma ha cambiado. Ahora se reconoce que, aunque algunas especies de peces de los arrecifes de coral del Caribe tienen poca o ninguna estructura genética entre las poblaciones, algunas tienen una subdivisión genética sustancial a lo largo de sus rangos y algunas tienen una estructura genética sutil pero presente. Ya no existe una regla de "talla única" para la genética de poblaciones de peces de arrecifes de coral del Caribe. En este estudio, hemos probado y caracterizado la estructura genética de la población de los peces de arrecife del Caribe *Acanthemblemaria aspera*, la cabeza áspera blenny. Se muestrearon poblaciones en todo el Caribe, así como en Yucatán. Se recogieron datos de secuencias de ADN para genes mitocondriales y nucleares. Estos datos se analizaron utilizando nuevos métodos bayesianos que permiten inferir la historia de colonización a través de un plano esférico. Utilizamos esto para construir un modelo que infería el lugar de la población original de *A. aspera* y las vías de dispersión de la especie en la cuenca del Caribe y el Golfo de México. En algunos escenarios, la población original, y las poblaciones de escalones, se infirió que estaban en lugares donde

aún no había recogido las muestras. Esto nos ha proporcionado un marco para guiar colecciones adicionales y extender nuestro trabajo a otras especies de peces caribeños del arrecife.

Keywords: phylogeography, coral reef fisheries

EXTENSIVE PHENOTYPIC VARIATION AMONG THE THREE CARIBBEAN ACROPORID CORALS

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The merging of two genomes through hybridization produces a unique combination of traits and phenotypic variation in the hybrids. This phenotypic variation may promote hybrid adaptation to habitats not accessible to the parent species. In the past, hybridization between Caribbean *Acropora palmata* and *A. cervicornis* corals was rare and restricted to the F1 generation. New genetic data indicates that hybrids are now mating with each other (F2) and are capable of mating with *A. palmata* and *A. cervicornis* (backcross). In parallel, a variety of intermediate morphologies to the arborescent staghorn and elkhorn shaped parental species are now observed. Here, we conducted morphometric analyses using high-resolution 3D scans and scanning electron microscopy on Caribbean acroporid colonies representing the continuum of phenotypes between *A. cervicornis* and *A. palmata* and correlated the data with the genetic origin of the hybrid (i.e., F1, F2 or backcross). Our results suggest that intermediate morphologies are not restricted to F1 hybrids, but a mixture of backcross and possibly F2 individuals. These data together with recent field observations of disease resistance and thermal tolerance, increased hybrid abundance, and hybrid habitat expansion suggests that the hybrids' ecological role and evolutionary potential is changing.

Keywords: hybridization, morphology, *A. prolifera*, adaptation

NOVEL PARASITES OF INVASIVE LIONFISH FROM ST KITTS AND THEIR POTENTIAL USE AS BIOLOGICAL TAGS

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Lionfish from the genus *Pterois* are native to the Indo-Pacific, but have been rapidly increasing in numbers in the western Atlantic and Caribbean Sea since they were accidentally released into the marine environment in the mid-1980s. They are now recognized as one of the most significant invasive species throughout the entire Caribbean region and their high numbers and feeding behavior are having a serious impact on coral reef biodiversity. Little has been documented about pathogens and parasites from these fish in their invasive Atlantic range, therefore, the aim of this study was to evaluate parasite load from fish that have been removed from the waters around St Kitts. Lionfish were speared by divers and taken directly to the laboratory for necropsy. All organs were examined for signs of gross pathology and fresh tissue preparations made to screen for the presence of microparasites using a compound microscope. Tissues that were observed to contain potential pathogens or parasites were prepared for histological examination and also preserved for DNA analysis, to assist in identification.
Two microparasites were observed that are currently being identified. Apicomplexan gammonts were observed in the urinary bladder, but no sporulated oocysts were present. Mature spores of a myxosporean were found in the gallbladder of some fish, which had a Zschokkella-like form. This data will be presented and discussed with respect to histopathological findings and initial microparasite identifications.

Keywords: Myxosporean, biological tag, lionfish.

THE EFFECTS OF NUTRIENT ADDITIONS ON THE GROWTH AND PHOTOSYNTHESIS OF PELAGIC *SARGASSUM* IN CARIBBEAN COASTAL AREAS BASED ON IN-SITU EXPERIMENTS

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Since 2011, the pelagic seaweed, *Sargassum* spp., has sporadically inundated the shores of the Caribbean and western Gulf of Mexico in unprecedented quantities. These events have not only lead to significant losses for the tourism and fisheries industries, but also damaged coastal ecosystems, such as the beaches and sea grass beds, by blocking light, depleting oxygen from coastal waters, and releasing hydrogen sulfide as it decomposes on beaches. Normally found in the nutrient-poor open ocean, we sought to determine how the growth of this seaweed changes as it nears coastal waters, subject to higher nutrient levels. We conducted 20-day in-situ growth experiments on two species of pelagic *Sargassum* found in the Caribbean, *S. fluitans* and a morphotype of *S. natans* that was previously thought to be *S. fluitans*, in order to determine the physiological differences between these species. We determined the effects of nutrient additions on growth rate and photosynthesis and found that *S. natans* grew significantly faster than *S. fluitans* in both treatments, with an average percent growth rate of 99% compared to 66%. This information is important in understanding the capacity of different species of pelagic *Sargassum* to alter coastal areas, since species have been found to host unique mobile fauna communities and may have different ecological impacts. With continued sporadic arrivals of *Sargassum* along the Caribbean coast, the information provided by this study offers more clues to help determine the nature and effects of these events.

Keywords: *Sargassum*, nutrients, growth rate, photosynthesis, Caribbean

FISH ASSEMBLAGES ON OUTPLANTED *ACROPORA CERVICORNIS* REEFS AND NATURAL REEFS IN SOUTHEAST, FLORIDA, USA

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The staghorn coral (*Acropora cervicornis*) has historically been a major contributor to reef structural complexity providing habitat for many fish and invertebrate species throughout Florida and the Caribbean. Unfortunately, due to impacts from disease, bleaching, and anthropogenic stressors, *A. cervicornis* populations have suffered drastic declines over the past several decades. In an attempt to preserve biodiversity, many organizations have turned to growing *A. cervicornis* in nurseries and outplanting them back onto the reef. This practice has been shown to be an effective method for increasing *A. cervicornis* abundance, however the effects on the local fish assemblage have not been thoroughly assessed. This gap is addressed by comparing fish populations on natural reefs to that of outplanted *A. cervicornis* reefs in southeast, Florida. Using the Reef Visual Census (RVC) method, surveys were conducted to record fish species and size at four locations biannually from 2012 to 2016. All four sites contained two control (natural) and three outplanted *A. cervicornis* reef arrays. Each reef array covered an area of approximately 80m2. A combined total of 40,259 fish and 136 species were counted on both reef types. Preliminary results show significantly higher fish density on natural reef, as well as significantly greater species richness. Labridae was the most abundant family on outplant reefs, and Haemulidae was the most abundant family on natural reefs. There was however, a non-significant increase in fish density at outplant sites over the course of the study as outplanted colonies increased in size. This suggests that outplanted reefs are not attracting the same fish as natural reefs, but fish density may continue to increase as *A. cervicornis* colonies grow.

Keywords: *Acropora cervicornis*, outplant, fish, natural

EFFECTS OF FLORIDA RED TIDES ON HISTONE VARIANT EXPRESSION AND DNA METHYLATION IN THE EASTERN OYSTER *CRASSOSTREA VIRGINICA*

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Massive algal proliferations known as Harmful Algal Blooms (HABs) represent one of the most important threats to coastal areas. Among them, the so-called Florida Red Tides (FRTs, caused by blooms of the dinoflagellate *Karenia brevis* and associated brevetoxins) are particularly detrimental in the southeastern U.S., causing high mortality rates and annual losses in excess of $40 million. The ability of marine organisms to cope with environmental stressors (including those produced during HABs) is influenced by genetic and epigenetic mechanisms, the latter resulting in phenotypic changes caused by heritable modifications in gene expression, without involving changes in the genetic (DNA) sequence. Yet, studies examining cause-effect relationships between environmental stressors, specific epigenetic mechanisms and subsequent responses are still lacking. The present work contributes to increase this knowledge by investigating the effects of Florida Red Tides on two types of mechanisms participating in the epigenetic memory of Eastern oysters: histone variants and DNA methylation. For that purpose, a HAB simulation was conducted in laboratory conditions, exposing oysters to increasing concentrations of *K. brevis*. The obtained results revealed, for the first time, the existence of H2A.X, H2A.Z and macroH2A genes in this organism, encoding histone variants potentially involved in the maintenance of genome integrity during responses to the genotoxic effect of brevetoxins. Additionally, an increase in H2A.X phosphorylation (γH2A.X, a marker of DNA damage) and a decrease in global DNA methylation were observed as the HAB simulation progressed. Overall, the present work provides a basis to better understand how epigenetic mechanisms participate in responses to environmental stress in marine invertebrates, opening new avenues to incorporate environmental epigenetics approaches into management and conservation programs.

Keywords: Epigenetics, Harmful Algal Blooms, Brevetoxins, Oysters, Histone Variants, DNA Methylation

CONNECTIVITY OF POPULATIONS AND GENE FLOW IN TOBAGO'S QUEEN CONCH *LOBATUS GIGAS* (LINNAEUS, 1758) POPULATION

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Tobago's queen conch fishery has seen a continued decline in productivity since the 1970s due to a lack of proper monitoring and management. With unregulated and unmonitored harvesting, Trinidad and Tobago remains unable to report on the status of the queen conch fishery, lending to the continuation of poor management.
Focusing on juvenile stages, the dispersal of local conch resources at larval stages via current flow can also be a key factor in its depletion, taking into consideration the magnitude of currents found in and around the Tobago coastal region. As such, it is necessary to determine the population's genetic structure, and to further identify whether there is indeed the potential for larval transport of Tobago's conch stock via existing current patterns. This study provides an improved understanding of connectivity of queen conch populations throughout the Caribbean, specifically in relation to population structures of queen conch in Tobago and their gene flow. It examines the potential for larval transport with the goal of testing the null hypothesis that geographically separated *Lobatus gigas* populations are genetically linked, by analysing gene flow as a means of differentiating the conch populations. Very little research has been done regarding Trinidad and Tobago's conch population, so this study will serve as a first look into the genetic population structures, and possibly give new insight into better approaches that facilitate more effective management of the resource. It also constitutes a first step in understanding the queen conch metapopulation structure, which will in turn, call for more local actions for the recovery and conservation of Tobago's populations.

Keywords: *Lobatus gigas*, queen conch, connectivity, gene flow, Tobago

VARIABILITY IN CORAL AND OCTOCORAL RECRUITMENT ALONG THE FLORIDA REEF TRACT

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There is consensus that recruitment failure is impeding coral recovery along the Florida Reef Tract (FRT), but how this parameter varies at the reef scale and through time is unknown. To fill this knowledge gap we are quantifying scleractinian and octocoral recruitment at 30 long-term monitoring sites across the FRT that are part of the Coral Reef Evaluation and Monitoring Project. At each site, 32 pairs of grooved terracotta settlement tiles (15 x 15cm) were attached to the substrate and retrieved after one year (n = 1,920 total tiles). There was high variability in recruitment among regions (i.e., SE Florida, upper, middle, and lower Keys) and even among sites within a region. There is a latitudinal shift in recruit position from upper to lower surfaces progressing from north to south along the FRT. Brooding scleractinians (with the exception of *Siderastrea siderea*) were most common and octocoral recruitment more localized. This study is informing reef management efforts of the regional differences in coral recruitment within the FRT suggesting that multiple management plans may need to be employed.

Keywords: coral, recruitment, resilience, settlement, octocoral

MANAGERIAL IMPLICATIONS OF PERCEPTIONS, KNOWLEDGE, ATTITUDES AND AWARENESS OF RESIDENTS REGARDINF PUERTO MORELOS REEF NATIONAL PARK, MEXICO

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This study explores the perceptions of local residents of Puerto Morelos, Quintana Roo, Mexico, concerning Puerto Morelos Reef National Park using semi-structured and key informant surveys. Collectively, the data provides qualitative and quantitative information regarding attitudes, knowledge, and awareness of park regulations and natural resources, as well as opinions about the formation and management of the protected area. The results show large differences in knowledge and awareness based on location of households within the community. Demographic indicators including education level, nationality, and length of community residence significantly correlate with perceptions about marine protection. There was a significant relationship between awareness of economic growth provided by the protected area and the level of support for protection, but many residents–particularly newer residents, those living farther inland, and those of lower educational levels—were unaware of the park, its resources, or its management. Further understanding of the relationships between social indicators and resource management is needed for conservation of important coastal resources. The results suggest that much more public outreach and education are needed within the region.

Keywords: Puerto Morelos Reef National Park, Marine Protected Areas, Human Dimensions

HISTOPATHOLOGICAL INVESTIGATION OF EMBRYONAL MORTALITY IN LEATHERBACK SEA TURTLES (*DERMOCHELYS CORIACEA*) IN ST. KITTS

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Critically endangered leatherback sea turtles (*Dermochelys coriacea*) have a low global hatch success of 50%, hence, protection of eggs and successful hatching are critical for population recovery. In St. Kitts, hatch success typically averages from 5-10%, much lower than the global and regional average, and too low to maintain the population in the decades to come. The aim of our research is to determine the causes of embryonal death in leatherback sea turtles. A histopathological survey of non-emergent late stage embryos and hatchlings was undertaken in 2015-16 on St. Kitts two main nesting beaches. In 2015, 3 hatchlings and 21 embryos were examined from 10 nests. In 2016, 6 hatchlings and 54 embryos were examined from 5 nests. Postmortem examinations were performed on the turtles. The only macroscopic abnormality identified was miliary white nodular foci in the lungs of 5 turtles. Histologically, this change corresponded to bronchopneumonia (12.5% prevalence) observed in 5 nests, representing both nesting beaches and seasons. In all cases the bronchopneumonia was associated with gram-negative rods-shaped bacteria. Aerobic and anaerobic cultures failed to identify a predominant isolate, however Pseudomonas sp. was found in a number of nests in 2016. Hematopoiesis was consistently observed in the liver, lung, kidneys, spleen, and pericardium, and is likely a normal event in the late development of *D. coriacea*. Other lesions included muscle necrosis (11% prevalence) and renal tubular mineralization (25% prevalence). Bacterial pneumonia appears to be a significant cause of death in St. Kitt's leatherback embryos and hatchlings. Further investigation is warranted to determine the causes of the lesions identified in this study, and their impact on hatch success in the wider Caribbean.

Keywords: Leatherback, Sea Turtle, Embryology, Histology, Pathology, Conservation

STONY CORAL MORTALITY ASSOCIATED WITH THE DISEASE OUTBREAK ALONG THE SOUTHEAST FLORIDA REEF TRACT

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The northern extent of the Florida Reef Tract, offshore Southeast Florida (USA) is formed by a series of linear reef structures along a highly developed coastline. The Southeast Florida Coral Reef Evaluation and Monitoring Project (SECREMP) has monitored reef conditions in this region via annual image analysis and transect data since 2003 with the addition of stony coral, gorgonian and barrel sponge demographic data in 2012. The project currently monitors 22 permanent sites distributed along the Florida Reef Tract from Martin County to Miami-Dade County. Starting in late 2014, increased disease prevalence, much appearing to be white-plague type, and disease related mortality were reported throughout the region. By summer 2016, significant region-wide declines in *Dichocoenia stokesii*, *Meandrina meandrites*, and *Montastraea cavernosa* densities were recorded. Significant *M. cavernosa* loss, one of the major contributors to regional stony coral cover, is of particular concern. *M. cavernosa* has historically been considered one of the hardiest species that commonly has large colonies on the reef. With disease observations continually reported for more than two years, it appears that the northern portion of the Florida Reef Tract is experiencing the greatest multi-species stony coral mortality event in recent times.

Keywords: Coral Disease, Southeast Florida, Coral Mortality, Disease Event

STUDY OF DISCRETE MORPHOMETRIC CHARACTERISTICS OF SAGITTAE OTOLITH OF LIONFISH (*PTEROIS VOLITANS*) IN PUERTO MORELOS

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The lionfish Pterois volitans, is the first species of non-native marine fish to settle along the western Atlantic coast of the USA, Caribbean Sea, and Gulf of Mexico, in part because of the wide-ranging environmental tolerances. This has added more concerns to the managers of the region's marine resources. Several authors have provided evidence that fish otolith shapes are species-specific, it is widely accepted that shape of sagittae otolith analysis can be used for age, population and species identification studies, and can provide necessary and relevant information for ecological studies. The study of shape properties is an important topic in pattern recognition and digital images processing, where the information is in the discrete domain, for this reason the implementation of discrete morphometric descriptors is necessary to obtain otolith shape characteristics from digital images, for this reason the purpose of this study was to analyze and quantify shape disparities of lionfish sagittae otoliths by the discrete morphometric measurements, for example tortuosity, compactness, and Euler number in the discrete domain. The left and right sagittae from 104 specimens of P. volitans were analyzed. All specimens were caught by fisher cooperative of Puerto Morelos, Quintana Roo, Mexico. All digital images were acquired by a Nikon DS-Ri1 camera coupled to a Nikon LMZ15000 optic microscope. In this case of the Mexican Caribbean, the morphological analysis did not show a particular pattern to classify the lionfish by classic descriptors. Thus, it was necessary to implement morphometric descriptors in the discrete domain that may help to characterize the otolith shape of the Caribbean lionfish. This study presents results of these discrete descriptors, on the similarity or dissimilarity between the left and right sagittae of P. volitans, and to asses and quantify the shape changes through the ontogeny of lionfish.

El pez león, *Pterois volitans*, es de las primeras especies marinas no nativas que se han establecido a lo largo de la costa atlántica occidental de los Estados Unidos de América, el mar Caribe y el Golfo de México, en parte debido a que tiene amplias tolerancias ambientales. El establecimiento del pez león a lo largo de estas áreas marinas ha aumentado las preocupaciones que enfrentan los administradores de los recursos marinos de la región.
Varios autores han aportado pruebas de que la forma de los otolitos en peces es específica de cada especie. El análisis de la forma del otolito sagitario puede utilizarse para estudios de edad, identificación de especies y stocks pesqueros o poblaciones, y puede proporcionar información necesaria y relevante para estudios ecológicos. El estudio de las propiedades de la forma es un tema importante en el reconocimiento de patrones y procesamiento de imágenes digitales, donde la información está en un dominio discreto, por esta razón la implementación de descriptores morfométricos discretos es necesaria para la extracción de características de forma a partir de imágenes digitales. El propósito de este estudio fue analizar y cuantificar las variaciones de forma de los otolitos sagita del pez león a partir de mediciones morfométricas discretas como por ejemplo la tortuosidad, la compacidad y el número de Euler en el dominio discreto. Se analizaron los otolitos sagita izquierdo y derecho de 104 ejemplares de *P. volitans*. Todas las especies fueron capturadas por la cooperativa pesquera de Puerto Morelos, Quintana Roo, México. La adquisición de imágenes digitales de

otolitos fue realizada por una cámara Nikon DS-Ri1 acoplada a un microscopio óptico Nikon LMZ15000. En este caso del pez león del Caribe mexicano, el análisis morfológico no mostró un patrón morfológico particular que nos ayude a clasificar esta especie a partir de descriptores morfométricos clásicos, por lo que fue necesario implementar descriptores morfométricos en el dominio discreto que nos ayudaran a caracterizar la forma del pez león. Este estudio presenta resultados de estos descriptores discretos sobre la similitud o disimilitud entre los otolitos sagita izquierdos y derechos de *P. volitans,* para corroborar y cuantificar los cambios en la forma de los otolitos a través de la ontogenia del pez león.

Keywords: Discrete morphometry, Lion fish, Puerto Morelos, Pattern recognition

DISEASE RESISTANCE IN THE THREATENED STAGHORN CORAL, *ACROPORA CERVICORNIS*

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The staghorn coral, *Acropora cervicornis*, is a major reef-building scleractinian coral found throughout Florida and the Caribbean that experienced dramatic population declines starting in the late1970s. The declines are attributed primarily to white-band disease (WBD and coral bleaching, and other tissue loss syndromes. Previous research in Panama indicates that disease-resistant genotypes exist. It is unknown if disease resistant genotypes exist in Florida Keys populations. We tested the potential for rapid tissue loss (RTL) resistance among 48 *A. cervicornis* genotypes maintained in a Florida Keys nursery by grafting active disease fragments to apparently healthy fragments. Tissue degradation was documented visually by the presence or absence of RTL (denoted by a characteristic margin where the zooxanthellate tissue is denuded from the skeleton), followed by histological analysis to further characterize potential tissue degradation. In this preliminary disease screening, 41 out of 48 genotypes did not show signs of rapid tissue loss transmission after five days. Only two control fragments showed signs of disease transmission. Continued histological analysis and a highly replicated disease transmission study in 2017 will help confirm disease resistance. These results will help inform and potentially increase the efficacy of future management strategies of *Acropora* populations.

El coral cuerno de ciervo, *Acropora cervicornis*, es uno de los mayores constructores de arrecifes de coral desde Florida hasta el Mar Caribe. Este coral escleractinio ha experimentado dramáticos descensos en sus poblaciones desde 1970. Las pérdidas de esta especie se han atribuido al blanqueamiento de coral, a la enfermedad de la banda blanca y a otros síndromes de pérdida de tejido. Investigaciones anteriores han indicaron que genotipos resistentes a dichas enfermedades existen en Panamá, sin embargo, hasta el momento no existe información de los genotipos resistentes en las poblaciones de los Cayos de la Florida. El presente estudio analizó la resistencia a la pérdida de tejido en 48 genotipos de A. cervicornis de una guardería de los Cayos de la Florida, mediante el injerto de fragmentos con enfermedad activa en fragmentos aparentemente sanos. La degradación de tejido fue documentada mediante análisis visual de presencia o ausencia de pérdida de tejido (exhibida por el margen característico en donde se presenta el tejido de la zooxantela separado del esqueleto coralino desnudo), así como el análisis histológico para caracterizar la degradación potencial de los tejidos. En el análisis preliminar, 41 de 48 genotipos no mostraron signos de transmisión del síndrome de pérdida de tejido después de cinco días de exposición. Los análisis histológicos posteriores y las réplicas del estudio de transmisión en 2017, ayudarán a confirmar la resistencia de los genotipos. Estos estudios en conjunto contribuirán a informar e incrementar la eficacia de las estrategias de manejo de las poblaciones de *Acropora* en el futuro.

Keywords: Coral, Disease, Acropora, Histology, Restoration

RECENT INFLUX OF PELAGIC *SARGASSUM* ONTO THE CUBAN COASTLINE

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In 2011, pelagic *Sargassum* in very large masses, was observed for the first time in the Tropical North Atlantic from Africa to the NE coast of South America and the eastern Caribbean. At first it was thought to arrive by spreading southward from the Sargasso Sea. But efforts at determining its origin suggested that it most likely was 'seeded' into the tropics and bloomed under favorable conditions. Satellite imagery shows that it is increasing over time and not a temporary condition. The *Sargassum* events has significantly impacted marine fisheries, shorelines, embayments and reefs of nations from the Lesser Antilles to NW Brazil and West Africa. In more recent years it has created major impacts within the Caribbean. In late October 2016, pelagic *Sargassum* in unusually large quantities was observed floating just offshore along the Malecón in Havana, Cuba. At the same time, mats and lines were washing ashore along Cayo Cocos, Cuba in such quantities as to require clean-up activities on the resort beaches. This ~450 Km stretch of coast has previously received pelagic Sargassum along its shoreline, but never has such a large and extensive event been recorded. It was thought that the small amounts previously received were coming from the Sargasso Sea through the Old Bahamas Channel or into the Caribbean via the Mona Passage. Using archived surface current data from a numerical ocean current model (HYcom), the *Sargassum* in this event was back tracked from observed landings in Havana and Cayo Cocos through the Caribbean and into the Tropical region of the Atlantic, passing through the Lesser Antilles in the previous July of 2016 as confirmed by satellite. Although the event in Cuba was relatively light compared to elsewhere in the Caribbean and the Tropical Atlantic, it does demonstrate that preparations for its influx should be made.

Keywords: pelagic *Sargassum*, currents, bloom, Caribbean, Tropical Atlantic

CONSECUTIVE WINTER BLEACHING EVENTS OBSERVED ON DEEPER REEF SITES NEAR CARRIE BOW CAY, BELIZE

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Ongoing reef monitoring efforts included bi-annual surveys at 24 permanent transects in the vicinity of Carrie Bow Cay, Belize. Starting in 2011, a comprehensive protocol assessed the abundance, species diversity, size distribution and condition of scleractinian corals and fishes on transects spanning four depth habitats from 5m-20m. Surveys from 2015-2017 recorded significant bleaching events persisting well into the winter months of December 2015 and January 2017. The number of colonies and species affected was positively correlated with depth. The greatest impact was observed at 20m. In 2015, bleaching recorded in December was largely sublethal, with less than 5% of bleaching colonies experiencing tissue mortality. However a second bleaching event, beginning in October 2016 and persisting into January 2017 produced significant amounts of coral mortality. Possible drivers including patterns of temperature, salinity, turbidity are explored.

Keywords: Coral Bleaching, Reef Monitoring

DETERMINATION OF THE DEGRADATION RATE OF LIONFISH EDNA IN THE LABORATORY

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Detection of the invasive lionfish in highly complex tropical ecosystems will require more than visual surveys and population control efforts will be more successful if lionfish removal is focused on areas known to have lionfish. Lionfish hunting is an effective strategy for controlling the lionfish population within recreational diving limits; especially on oceanic islands with fringing reefs. Mangrove habitats are difficult ecosystems for lionfish hunting and new methods are needed to detect lionfish. Mangroves are important areas for juvenile reef fish and some species require mangroves in the juvenile stages. In freshwater ecosystems, environmental DNA (eDNA) techniques have become widely used due to their success in detecting target species, and recently eDNA techniques started being utilized in marine ecosystems. An important component for determining lionfish density in mangroves will be to determine the degradation rate of lionfish eDNA in the laboratory. To determine the average degradation time of lionfish eDNA, water samples from aquariums that held one lionfish for 24 h were sampled over nine days. Water was filtered to extract DNA from seawater samples. DNA was amplified, and gels were run using electrophoresis. The degradation rates determined using this technique will be used in parallel with another study in our laboratory to detect lionfish DNA on coral reefs where the exact location of the lionfish is known. This study will result in the ability to estimate the presence on lionfish within an important parameter; the rate of degradation and that will contribute to developing the technique required to determine locations of lionfish for removal.

Keywords: Lionfish, environmental DNA, eDNA, degradation

ADAPTATION AND RESILIENCE IN A CHANGING CLIMATE: CRYPTIC *SYMBIODINIUM* SP. IN FLORIDA'S PILLAR CORAL OFFER A GLIMMER OF HOPE

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Like many coral reefs worldwide, the Florida Reef Tract (FRT) experienced two consecutive hyperthermal bleaching events during the summers of 2014 and 2015. The iconic and unique pillar coral, *Dendrogyra cylindrus*, suffered severe bleaching throughout the 320 km FRT. While all D. cylindrus colonies bleached severely during summer 2014, one Upper Keys site appeared more resistance to bleaching during the 2015 event and returned to normal coloration more quickly than some sites in the Middle and Lower Keys. This pattern of resistance was linked to a shift of the dominant Symbiodinium species associated with *D. cylindrus*. Following the first bleaching event in September 2014, we observed a rapid change in dominance from the typically hosted *Symbiodinium* 'dendrogyrum' to the cryptic S. 'meandrinium', where the dominance of this latter persisted throughout the second bleaching event in August/September 2015 and through April 2016. The fine taxonomic resolution achieved in this study through the use high-throughput amplicon sequencing of the chloroplast 23S hypervariable region allowed the discovery of an ecologically relevant shift and a glimmer of hope for adaptation and resilience for corals in a changing climate.

Keywords: adaptation, *Dendrogyra cylindrus*, Florida Reef Tract, hyperthermal bleaching, pillar coral, resilience

CARBON SOURCES SUPPORTING FOOD CHAINS IN A MANGROVE FOREST AND ADJACENT INTERTIDAL MUDFLATS: A STABLE ISOTOPE TECHNIQUE FOR ASSESSING ECOSYSTEM CONNECTIVITY

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The abundance of food resources has been promoted as one of the principal attributes of mangroves and mudflats as nursery habitats for juvenile fish. Identifying the primary producers sustaining these food webs is the foundation for informed management plans to conserve biodiversity and commercial resources in a habitat mosaic. These habitats are also thought to be interlinked through diurnal or tidal fish migrations and carbon exchange. We use carbon and nitrogen stable isotope analysis (SIA) of primary producers, benthic and planktonic meiofauna, invertebrates, fishes and birds to identify the autotrophs underpinning food webs in a mangrove forest and adjacent intertidal mudflat in the Gulf of Paria, Trinidad and Tobago. We find isotopically distinct food webs in the two habitats, and even isotopic distinctions for the same species collected in both habitats. MixSIAR mixing models show that mangrove carbon does not support fish populations in an adjacent mudflat ecosystem and may only partially support fishes in mangroves along with other carbon sources. This reaffirms findings from previous studies that question the role of mangrove carbon in food webs and the 'outwelling' hypothesis. In both habitats, phytoplankton and/or benthic microalgae support foodwebs for fishes and waterfowl. We observed little evidence of connectivity between the two habitats in terms of carbon exchange and feeding migrations for several planktivorous and demersal fish species. We present the possible reasons for this habitat isolation and what it means for management of fish nursery habitats.

Keywords: mangrove, mudflat, fish, nursery, isotopes, food webs

IMPACT OF WATER TEMPERATURE INCREASE IN THE PHOTOSYNTHESIS AND CALCIFICATION/GROWTH RATE OF THREE LIFE STAGES OF *PORITES ASTREOIDES*

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A rise in sea surface temperature can affect corals physiological processes in different ways during each development stage. Here, we determine the impact of temperature increase on symbiont photosynthesis and growth/calcification of coral host in *Porites astreoides* at different developmental stages which include swimming larvae, newly settled juveniles and adults. Photosynthetic efficiency (Fv/Fm') of symbionts in adults and larvae were measured using a Diving PAM (Walz). Calcification rates of adults were measured using the buoyant weight technique, and the growth rates of the swimming larvae and newly settled juveniles were measured using light microscopy and Image J-Fiji software. The temperature treatments include 28°C, an intermediate mildly stressful temperature of 30°C, and a third treatments of 32°C which is the threshold for bleaching, Photosynthetic efficiency of the swimming larvae was not affected by temperature increase, meanwhile, newly settled juveniles exhibited more variation in Fv/Fm values. The adult stages showed a dramatic decrease in photosynthetic efficiency. No significant changes with increase in temperature were observed in growth rates for the swimming larvae and newly settled juveniles. However, the calcification rate of the adults slightly increased at higher temperature. Thus, the susceptibility to thermal stress varies depending on the life stage.

Keywords: *Porites astreoides*, temperature increase, photosynthesis, calcification, life stages

GRAZING BY GREEN TURTLES INDUCED A COMMUNITY SHIFT FROM CLIMAX TO EARLY SUCCESSIONAL SPECIES IN THE CARIBBEAN.

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In the Caribbean, Green turtles (*Chelonya mydas*) practice rotational grazing where *Thalassia testudinum* grazing patches are used for up to 2 years, after which these patches are abandoned. This study examined the effects of simulating grazing (clipping) by green turtles on both ungrazed and grazed abandoned seagrass patches during different periods. Treatments included 0 (control, no grazing), 4, and 8 months of simulating clipping, and treatments for grazed abandoned patches were 8 months of clipping and 8 months of recovery without clipping. Grazing resulted in a decrease in shoot density and below ground biomass for the preferred turtle food *T. testudinum*, while an increase in these parameters was observed for the faster growing seagrass *Syringodium filiforme*. By contrast, *T. testudinum* leaf length, leaf width, foliar shoot density, and biomass were negatively affected by the simulated grazing. As grazing time increased, *T. testudinum* leaf C/N-ratios decreased and ammonium pore water levels increased, suggesting a reduced demand for nitrogen by *T. testudinum*. Patches with 8 months of clipping after abandonment showed rhizome soluble carbohydrate content and leaf tannin concentration greatly reduced, suggesting a total depletion of energetic and carbon reserves. This latter was confirmed by an increase in carbohydrate reserves in *T. testudinum* from the abandoned patches that had recovered for 8 months. This time series showed that grazing on *T. testudinum* cause carbon depletion and increase the ammonia in the sediments. Ammonia is a resource available for the fast growing *S. filiforme*, causing a community shift from *T. testudinum* into *S. filiforme*.

En el Caribe la tortuga verde (*Chelonya mydas*) practica pastoreo rotacional en pastizales marinos dominados por *Thalassia testudinum*, manteniendo parcelas ramoneadas hasta por dos años que posteriormente son abandonadas. Este estudio analizó el efecto de la herbivoría por tortugas utilizando parcelas sin pastoreo y parcelas abandonadas de manera natural. Los tratamientos consistieron en diferentes niveles de intensidad de herbivoría (tiempo). En parcelas sin pastoreo previo se estableció el control (nivel 0), y dos niveles adicionales simulando el pastoreo de tortugas (clipping) durante 4 y 8 meses respectivamente. En parcelas abandonadas, se estableció un tratamiento con herbivoría artificial por 8 meses y uno más con 8 meses de recuperación (no herbivoría simulada). El pastoreo resultó en una disminución en la densidad de haces y biomasa subterránea para la especie preferida por las tortugas *T. testudinum*. Los mismos parámetros incrementaron para la especie de crecimiento rápido *Syringodium filiforme*. Al aumentar el tiempo de pastoreo, disminuyó la longitud, ancho y proporción de C/N en hojas de *T. testudinum*. En cambio la concentración de amonio incrementó en el agua intersticial del sedimento, que sugiere una disminución en la demanda de nitrógeno por *T. testudinum*. Las parcelas abandonadas y con pastoreo artificial por 8 meses, mostraron las menores

concentraciones de carbohidratos solubles en los rizomas y de contenido de taninos en hojas, como una posible causa de la reducción en sus reservas energéticas y de carbono. Esto concuerda con el aumento de carbohidratos solubles de *T. testudinum* en las parcelas abandonadas naturalmente pero con 8 meses de recuperación. Se sugiere que una pérdida en las reservas de carbohidratos solubles en los rizomas de *T. testudinum* y el aumento de amonio disponible en el sedimento, favorecen un cambio en la comunidad de pastos marinos hacia una mayor abundancia de especies de crecimiento rápido como *S. filiforme*.

Keywords*:* *Chelonya mydas*, seagrass, grazing, clipping, *Thalassia testudinum*, *Syringodium filiforme*

MARINE PROTECTED AREAS AND CORAL REEF RESILIENCY, CAYMAN ISLANDS

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Coral reefs in the Caribbean region have experienced widespread coral cover loss over the past 3 decades, primarily due to hurricanes, coral disease outbreaks, loss of "keystone" herbivores, coral bleaching, eutrophication and overfishing. Centrally located in the NW Caribbean, the Cayman Islands established a system of Marine protected areas in 1986. The current study aims to assess the benthic community composition at 40 sites around Grand Cayman, Little Cayman and Cayman Brac, for the years 2009, 2012, 2015 and 2016. Benthic community was analyzed and compared between MPAs and non-MPA areas across islands on their shallow and deep reef terrace reefs. Results revealed a low hard coral cover average across islands in 2009 of 9.5% and Macro-algae showing 79.44% cover to a much high coral cover average in 2016 of 21.7%, and a much lower macro algae cover of 42.2%. The remaining % benthic cover was composed of soft corals, crustose coralline algae, sand, rubble and dead corals. Comparisons between the three islands showed that the less developed Sister Islands had a higher coral cover compared to the more developed Grand Cayman. Additionally, the macro algal cover was higher in Grand Cayman and Cayman Brac. The two most abundant coral species within the waters of the Cayman Islands comprised the encrusting corals *Agaricia* and *Porites* spp. The high percentage cover of macro algae cover, which predominantly composed of *Dictyot*a and *Lobophora*. Analysis showed a higher species abundance along the southern coastlines and within the shallower reef systems. A temporal analysis demonstrated a significant increase in the cover of hard coral species across all the islands, with a net decrease in the macro algae cover. Following several bleaching and hurricane events during recent years, the Cayman Islands showed positive signs of recovery and suggest the presence of resilient reefs, especially within the MPAs.

Los arrecifes de coral en la región del Caribe han experimentado pérdidas generalizadas de cubierta coralina durante las últimas 3 décadas, principalmente debido a huracanes, brotes de enfermedades de coral, pérdida de herbívoros "clave", blanqueamiento de corales, eutrofización y sobrepesca. El presente estudio tiene como objetivo evaluar la composición de la comunidad bentónica en 40 sitios alrededor de Grand Caiman, Little Caiman y Caiman Brac, para los años 2009, 2012, 2015 y 2016. La comunidad bentónica fue analizada y comparada entre áreas protegidas marinas y áreas no protegidas a través de islas en sus arrecifes de arrecifes superficiales y profundos. Los resultados revelaron un promedio de cobertura de coral duro bajo en las islas en 2009 de 9.5% y Macroalgas mostrando un 79.44% cubriendo un promedio de cubierta de coral muy alto en 2016 de 21.7% y una cobertura de macro algas mucho más baja de 42.2%. El resto de la cubierta bentónica estaba compuesta por corales blandos, algas coralinas crustosas, arena, escombros y corales muertos. Las comparaciones entre las tres islas mostraron que las islas hermanas menos desarrolladas tenían una cubierta de coral más alta en comparación

con el Grand Caiman más desarrollado. Además, la cobertura macro algas fue mayor en Gran Caimán y Caiman Brac. Las dos especies de coral más abundantes dentro de las aguas de las Islas Caimán comprendían los incrustantes corales *Agaricia* y *Porites* spp. El alto porcentaje de cobertura de algas macro cubiertas, que se compone principalmente de *Dictyota* y *Lobophora*. El análisis mostró una mayor abundancia de especies a lo largo de las costas del sur y dentro de los sistemas de arrecifes menos profundos. Un análisis temporal demostró un aumento significativo en la cubierta de especies de corales duros en todas las islas, con una disminución neta en la cobertura de macroalgas. Después de varios episodios de blanqueo y huracán durante los últimos años, las Islas Caimán mostraron signos positivos de recuperación y sugieren la presencia de arrecifes resistentes, especialmente dentro de las MPAs.

Keywords: Marine protected areas, Cayman Islands, Coral reef resilience

CORAL BLEACHING IN THE MESOAMERICAN REGION (2015-2016)

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The Mesoamerican Reef extends for over 100km across the Caribbean coasts of Mexico, Belize, Guatemala and Honduras. It has experienced at least six bleaching events since the first recorded in 1995, including the 2015/2016 third global mass bleaching event, currently affecting reefs worldwide. In order to assess the extent of coral bleaching and its potential impacts in the Mesoamerican region (MAR), the Healthy Reefs Initiative led a regional Coral Bleaching Emergency Response Plan in partnership with 19 regional organizations. Surveyors quickly mobilized across the MAR region to monitor over 100 sites in October/November 2015 and again in 2016 assessing a total of 33,890 corals. Overall, the Mesoamerican Reef was moderately affected by this bleaching event, with 36% of corals “affected” in 2015 and 49% affected in 2016. Both years approximately half of the colonies were pale and half were either partly of fully bleached. The number of fully bleached corals increased from 3% to 5% from 2015 to 2016, while the partially bleached category increased from 15% to 20% of the colonies. Overall, Honduras was the most affected country (73%) followed by Mexico (47%) then Guatemala (33%) and Belize (23%). Some of the main reef building coral species were also the most severely bleached, in terms of percent of colonies partly or fully bleached, including *Orbicella franksii* (42%), O. annularis (34%) and *O. faveolata* (26%) and *Undaria tenuifolia* (35%). The two-year $40,000 project involved 23 sub-grants organized by the four HRI country coordinators and administered by the Mesoamerican Reef Fund, which is establishing an Emergency Response Fund that could assist with future events.

El Arrecife Mesoamericano se extiende por más de 100km a lo largo de las costas caribeñas de México, Belice, Guatemala y Honduras. Esta zona ha experimentado al menos seis episodios masivos de blanqueamiento de coral desde el primer registro en 1995, incluyendo el tercer evento global (2015/2016), que afecta actualmente a los arrecifes nivel global. Con el fin de evaluar el grado de blanqueamiento y sus posibles impactos en la región de Mesoamérica, la Iniciativa de Arrecifes Saludables (HRI) llevó a cabo un Plan Regional de Respuesta de Emergencia de Blanqueamiento de Coral en colaboración con 19 organizaciones regionales. Las organizaciones se movilizaron rápidamente en toda la región del Sistema Arrecifal Mesoamericano (SAM) para monitorear más de 100 sitios en octubre/noviembre de 2015 y de nuevo en 2016 evaluando un total de 33,890 corales. En general, el SAM fue moderadamente afectado por este evento de blanqueamiento, con el 36% de los corales "afectados" en 2015 y el 49% afectados en 2016. En ambos años aproximadamente la mitad de las colonias estaban pálidas y la mitad fueron parcialmente blanqueadas. El número de corales completamente blanqueados aumentó del 3% a 5% de 2015 a 2016,

mientras que la categoría parcialmente blanqueada aumentó de 15% a 20% de las colonias. En general, Honduras fue el país más afectado (73%), seguido por México (47%), Guatemala (33%) y Belice (23%). Algunas de las principales especies de corales que se fueron severamente blanqueadas, en términos de porcentaje de colonias parcialmente o totalmente blanqueadas, incluyen *Orbicella franksii* (42%), *O. annularis* (34%) y *O. faveolata* (26%) y Undaria tenuifolia (35%). El proyecto de dos años de $40,000 involucró 23 subsidios organizados por los cuatro coordinadores de países de HRI y administrados por el Fondo Arrecifal Mesoamericano, que está estableciendo un Fondo de Respuesta a Emergencias que podría financiar futuros eventos de blanqueamiento.

Keywords: coral reefs, bleaching index, Mesoamerican region, degree heating weeks

ON THE RELATIONSHIP BETWEEN PARTIAL MORTALITY AND THE DEMOGRAPHICS OF *ACROPORA CERVICORNIS*

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Understanding how coral populations respond to partial mortality of the colonies is essential to evaluate population persistence under unfavorable environmental conditions, such as elevated sea water temperature, high sedimentation rates, and strong wave surge due to storms. Coral species that contribute significantly to the structure and function of coral reefs are of interest. The aim of this study was to test the hypothesis that partial mortality sets back the demographic performance of the threatened reef-builder coral *Acropora cervicornis*. We followed, for two years, the fate (growth and survival) of colonies with varying degree of partial mortality indicated by tissue loss, at two reefs in Puerto Rico. Partial mortality limited colony growth and increased the odds of death. A simple stage-based matrix population model indicated that at an increasing number of colonies with more than 20% of partial mortality, the time to reach a quasi-extinction level (set at 25% of the original population size) was reduced considerably. Thus, the partial mortality of colonies should be taken into consideration when evaluating the population dynamics of *A. cervicornis*.

Keywords: *Acropora cervicornis*, partial mortality, extinction, colony conditions

MULTI-AGENCY RESCUE OF THE THREATENED PILLAR CORAL ALONG THE FLORIDA REEF TRACT

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Pillar coral (*Dendrogyra cylindrus*) is a rare but conspicuous Caribbean coral, and the only species in its genus. It was listed as threatened under the U.S. Endangered Species Act in 2014 by NOAA Fisheries due to a combination of threats including ocean warming, ocean acidification, and disease. Once a species is added to the Endangered Species List, NOAA Fisheries engages in planning and implementation of recovery actions to provide for the conservation of the species. In 2016, a severe mortality event, beginning in 2014, affecting the entire Florida population of pillar coral was reported. The dramatic decline prompted a multi-agency coordinated effort to "rescue" fragments of as may extant genotypes as possible to provide a genetic "Noah's Ark" as well as investigate viable restoration techniques. The high-level of collaboration and dedication by the partner agencies, catalyzed by the species' threatened status, is a success story despite the dire status of the Florida population.

Keywords: Threatened, Endangered Species Act, pillar coral, *Dendrogyra cylindrus*, restoration, Florida, disease.

COLLAPSE, RESCUE, AND POTENTIAL RESTORATION OF FLORIDA'S PILLAR CORAL *DENDROGYRA CYLUNDRUS.*

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The pillar coral *Dendrogyra cylindrus* has undergone a catastrophic 70% population decline on the Florida Reef Tract since 2014 due to back-to-back bleaching events and an expanding disease outbreak. The estimated number of surviving genotypes within the population has declined from 142 to 79, and the Florida inhabitants are assumed to be reproductively extinct and at high risk for regional extinction. In response to this decline, restoration efforts were rapidly scaled up from experimental microfragging and larval rearing trials to full-scale genetic banking. From an estimated 142 genotypes along the Florida Reef Tract, an estimated 70 have gone extinct. Of the remaining genotypes, 20% exist only within onshore conservation and research facilities. These facilities are researching disease treatment, fragmenting strategies, and methods to promote tissue growth. Juvenile settlement and growth of the species has also been achieved from wild-spawning parents. Partnerships between federal, state, academic, and non-profit agencies has allowed for the rapid response and care for this species to salvage what remains of the population for future restoration.

Keywords: Restoration, Disease, *Dendrogyra cylindrus* Spawning, Population, Coral, Florida

DEVELOPMENT OF A MOLECULAR ASSAY FOR CARIBBEAN CORAL IDENTIFICATION

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As coral cover has declined throughout the Caribbean, interest in determining the potential for reef recovery via natural recruitment processes has increased. Studies investigating recruitment processes have been hampered by the difficulty of identifying larvae or recently settled recruits that often lack distinguishing morphological characters. To overcome these constraints, the development of molecular tools to recognize species at early life stages are required. In this study, we investigated the utility of targeting the non-coding internal transcribed spacer (ITS) regions with a multiplex PCR assay to identify common Caribbean coral species. To design this assay, we developed a database of ITS sequences for 17 different Caribbean scleractinian coral species that are important reef builders, or are common. Analyzing the ITS region, we detected sufficient genetic variation to allow for potential differentiation of nine Caribbean coral species to the genus level, and eight to the species level. We subsequently designed a set of three genus-specific primers (with a total of seven included species) and six species-specific primers for use in a single-step nested multiplex PCR protocol that facilitates coral identification. We were unable to successfully design primers for five species that were included in the database. While still under development, this genetic assay shows significant promise as an inexpensive and relatively straightforward method of identifying planula larvae and recently settled coral recruits to the genus or species level. The increased accuracy and abbreviated timeframe offered by this technique for identifying larvae and recruits will be a valuable tool in evaluating Caribbean reef recovery moving forward.

Keywords: Corals, molecular assay, single-step nested multiplex PCR, internal transcribed spacer regions 1 and 2

SARGASSUM INFLUXES: UNDERSTANDING THE CAUSES AND CONSEQUENCES IN THE CARIBBEAN

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Since 2011, the Caribbean has been affected by periodic mass influxes of pelagic *Sargassum* seaweed. These events have resulted in mass inundating of coastlines, harbors, bays and beaches by the weed and significant disruption of the fisheries and tourism sectors across the region with social and economic consequences. There have also been negative impacts to sensitive coastal habitats and species produced by the decomposition of the algae. These events, which are unprecedented in the southern, central and eastern Caribbean as far back as records exist, have caused many misconceptions and confusion about the causes and sources of the massive *Sargassum* influxes to this region, raising questions about whether they represent a 'new norm' under the current climate change scenario. This presentation answers the call for better communication of the current scientific knowledge regarding *Sargassum* influxes and presents the progress with developing predictive models to provide early warning of future events. It also highlights the many areas in need of further research and monitoring.

Keywords: *Sargassum* influxes, Caribbean, Climate Change.

STONY CORAL MORTALITY ASSOCIATED WITH THE DISEASE OUTBREAK ALONG THE SOUTHEAST FLORIDA REEF TRACT

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The northern extent of the Florida Reef Tract, offshore Southeast Florida (USA) is formed by a series of linear reef structures along a highly developed coastline. The Southeast Florida Coral Reef Evaluation and Monitoring Project (SECREMP) has monitored reef conditions in this region via annual image analysis and transect data since 2003 with the addition of stony coral, gorgonian and barrel sponge demographic data in 2012. The project currently monitors 22 permanent sites distributed along the Florida Reef Tract from Martin County to Miami-Dade County. Starting in late 2014, increased disease prevalence, much appearing to be white-plague type, and disease related mortality were reported throughout the region. By summer 2016, significant region-wide declines in *Dichocoenia stokesii*, *Meandrina meandrites*, and *Montastraea cavernosa* densities were recorded. Significant *M. cavernosa* loss, one of the major contributors to regional stony coral cover, is of particular concern. *M. cavernosa* has historically been considered one of the hardiest species that commonly has large colonies on the reef. With disease observations continually reported for more than two years, it appears that the northern portion of the Florida Reef Tract is experiencing the greatest multi-species stony coral mortality event in recent times.

Keywords: Coral Disease, Southeast Florida, Coral Mortality, Disease Event

STUDY OF DISCRETE MORPHOMETRIC CHARACTERISTICS OF SAGITTAE OTOLITH OF LIONFISH (*PTEROIS VOLITANS*) IN PUERTO MORELOS

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The lionfish Pterois volitans, is the first species of non-native marine fish to settle along the western Atlantic coast of the USA, Caribbean Sea, and Gulf of Mexico, in part because of the wide-ranging environmental tolerances. This has added more concerns to the managers of the region's marine resources. Several authors have provided evidence that fish otolith shapes are species-specific, it is widely accepted that shape of sagittae otolith analysis can be used for age, population and species identification studies, and can provide necessary and relevant information for ecological studies. The study of shape properties is an important topic in pattern recognition and digital images processing, where the information is in the discrete domain, for this reason the implementation of discrete morphometric descriptors is necessary to obtain otolith shape characteristics from digital images, for this reason the purpose of this study was to analyze and quantify shape disparities of lionfish sagittae otoliths by the discrete morphometric measurements, for example tortuosity, compactness, and Euler number in the discrete domain. The left and right sagittae from 104 specimens of P. volitans were analyzed. All specimens were caught by fisher cooperative of Puerto Morelos, Quintana Roo, Mexico. All digital images were acquired by a Nikon DS-Ri1 camera coupled to a Nikon LMZ15000 optic microscope. In this case of the Mexican Caribbean, the morphological analysis did not show a particular pattern to classify the lionfish by classic descriptors. Thus, it was necessary to implement morphometric descriptors in the discrete domain that may help to characterize the otolith shape of the Caribbean lionfish. This study presents results of these discrete descriptors, on the similarity or dissimilarity between the left and right sagittae of P. volitans, and to asses and quantify the shape changes through the ontogeny of lionfish.

El pez león, *Pterois volitans*, es de las primeras especies marinas no nativas que se han establecido a lo largo de la costa atlántica occidental de los Estados Unidos de América, el mar Caribe y el Golfo de México, en parte debido a que tiene amplias tolerancias ambientales. El establecimiento del pez león a lo largo de estas áreas marinas ha aumentado las preocupaciones que enfrentan los administradores de los recursos marinos de la región.
Varios autores han aportado pruebas de que la forma de los otolitos en peces es específica de cada especie. El análisis de la forma del otolito sagitario puede utilizarse para estudios de edad, identificación de especies y stocks pesqueros o poblaciones, y puede proporcionar información necesaria y relevante para estudios ecológicos. El estudio de las propiedades de la forma es un tema importante en el reconocimiento de patrones y procesamiento de imágenes digitales, donde la información está en un dominio discreto, por esta razón la implementación de descriptores morfométricos discretos es necesaria para la extracción de características de forma a partir de imágenes digitales. El propósito de este estudio fue analizar y cuantificar las variaciones de forma de los otolitos sagita del pez león a partir de mediciones morfométricas discretas como por ejemplo la tortuosidad, la compacidad y el número de Euler en el dominio discreto. Se analizaron los otolitos sagita izquierdo y derecho de 104 ejemplares de *P. volitans*. Todas las especies fueron capturadas por la cooperativa pesquera de Puerto Morelos, Quintana Roo, México. La adquisición de imágenes digitales de

otolitos fue realizada por una cámara Nikon DS-Ri1 acoplada a un microscopio óptico Nikon LMZ15000. En este caso del pez león del Caribe mexicano, el análisis morfológico no mostró un patrón morfológico particular que nos ayude a clasificar esta especie a partir de descriptores morfométricos clásicos, por lo que fue necesario implementar descriptores morfométricos en el dominio discreto que nos ayudaran a caracterizar la forma del pez león. Este estudio presenta resultados de estos descriptores discretos sobre la similitud o disimilitud entre los otolitos sagita izquierdos y derechos de *P. volitans,* para corroborar y cuantificar los cambios en la forma de los otolitos a través de la ontogenia del pez león.

Keywords: Discrete morphometry, Lion fish, Puerto Morelos, Pattern recognition

DISEASE RESISTANCE IN THE THREATENED STAGHORN CORAL, *ACROPORA CERVICORNIS*

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The staghorn coral, *Acropora cervicornis*, is a major reef-building scleractinian coral found throughout Florida and the Caribbean that experienced dramatic population declines starting in the late1970s. The declines are attributed primarily to white-band disease (WBD and coral bleaching, and other tissue loss syndromes. Previous research in Panama indicates that disease-resistant genotypes exist. It is unknown if disease resistant genotypes exist in Florida Keys populations. We tested the potential for rapid tissue loss (RTL) resistance among 48 *A. cervicornis* genotypes maintained in a Florida Keys nursery by grafting active disease fragments to apparently healthy fragments. Tissue degradation was documented visually by the presence or absence of RTL (denoted by a characteristic margin where the zooxanthellate tissue is denuded from the skeleton), followed by histological analysis to further characterize potential tissue degradation. In this preliminary disease screening, 41 out of 48 genotypes did not show signs of rapid tissue loss transmission after five days. Only two control fragments showed signs of disease transmission. Continued histological analysis and a highly replicated disease transmission study in 2017 will help confirm disease resistance. These results will help inform and potentially increase the efficacy of future management strategies of *Acropora* populations.

El coral cuerno de ciervo, *Acropora cervicornis*, es uno de los mayores constructores de arrecifes de coral desde Florida hasta el Mar Caribe. Este coral escleractinio ha experimentado dramáticos descensos en sus poblaciones desde 1970. Las pérdidas de esta especie se han atribuido al blanqueamiento de coral, a la enfermedad de la banda blanca y a otros síndromes de pérdida de tejido. Investigaciones anteriores han indicaron que genotipos resistentes a dichas enfermedades existen en Panamá, sin embargo, hasta el momento no existe información de los genotipos resistentes en las poblaciones de los Cayos de la Florida. El presente estudio analizó la resistencia a la pérdida de tejido en 48 genotipos de A. cervicornis de una guardería de los Cayos de la Florida, mediante el injerto de fragmentos con enfermedad activa en fragmentos aparentemente sanos. La degradación de tejido fue documentada mediante análisis visual de presencia o ausencia de pérdida de tejido (exhibida por el margen característico en donde se presenta el tejido de la zooxantela separado del esqueleto coralino desnudo), así como el análisis histológico para caracterizar la degradación potencial de los tejidos. En el análisis preliminar, 41 de 48 genotipos no mostraron signos de transmisión del síndrome de pérdida de tejido después de cinco días de exposición. Los análisis histológicos posteriores y las réplicas del estudio de transmisión en 2017, ayudarán a confirmar la resistencia de los genotipos. Estos estudios en conjunto contribuirán a informar e incrementar la eficacia de las estrategias de manejo de las poblaciones de *Acropora* en el futuro.

Keywords: Coral, Disease, Acropora, Histology, Restoration

RECENT INFLUX OF PELAGIC *SARGASSUM* ONTO THE CUBAN COASTLINE

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In 2011, pelagic *Sargassum* in very large masses, was observed for the first time in the Tropical North Atlantic from Africa to the NE coast of South America and the eastern Caribbean. At first it was thought to arrive by spreading southward from the Sargasso Sea. But efforts at determining its origin suggested that it most likely was 'seeded' into the tropics and bloomed under favorable conditions. Satellite imagery shows that it is increasing over time and not a temporary condition. The *Sargassum* events has significantly impacted marine fisheries, shorelines, embayments and reefs of nations from the Lesser Antilles to NW Brazil and West Africa. In more recent years it has created major impacts within the Caribbean. In late October 2016, pelagic *Sargassum* in unusually large quantities was observed floating just offshore along the Malecón in Havana, Cuba. At the same time, mats and lines were washing ashore along Cayo Cocos, Cuba in such quantities as to require clean-up activities on the resort beaches. This ~450 Km stretch of coast has previously received pelagic Sargassum along its shoreline, but never has such a large and extensive event been recorded. It was thought that the small amounts previously received were coming from the Sargasso Sea through the Old Bahamas Channel or into the Caribbean via the Mona Passage. Using archived surface current data from a numerical ocean current model (HYcom), the *Sargassum* in this event was back tracked from observed landings in Havana and Cayo Cocos through the Caribbean and into the Tropical region of the Atlantic, passing through the Lesser Antilles in the previous July of 2016 as confirmed by satellite. Although the event in Cuba was relatively light compared to elsewhere in the Caribbean and the Tropical Atlantic, it does demonstrate that preparations for its influx should be made.

Keywords: pelagic *Sargassum*, currents, bloom, Caribbean, Tropical Atlantic

CONSECUTIVE WINTER BLEACHING EVENTS OBSERVED ON DEEPER REEF SITES NEAR CARRIE BOW CAY, BELIZE

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Ongoing reef monitoring efforts included bi-annual surveys at 24 permanent transects in the vicinity of Carrie Bow Cay, Belize. Starting in 2011, a comprehensive protocol assessed the abundance, species diversity, size distribution and condition of scleractinian corals and fishes on transects spanning four depth habitats from 5m-20m. Surveys from 2015-2017 recorded significant bleaching events persisting well into the winter months of December 2015 and January 2017. The number of colonies and species affected was positively correlated with depth. The greatest impact was observed at 20m. In 2015, bleaching recorded in December was largely sublethal, with less than 5% of bleaching colonies experiencing tissue mortality. However a second bleaching event, beginning in October 2016 and persisting into January 2017 produced significant amounts of coral mortality. Possible drivers including patterns of temperature, salinity, turbidity are explored.

Keywords: Coral Bleaching, Reef Monitoring

DETERMINATION OF THE DEGRADATION RATE OF LIONFISH EDNA IN THE LABORATORY

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Detection of the invasive lionfish in highly complex tropical ecosystems will require more than visual surveys and population control efforts will be more successful if lionfish removal is focused on areas known to have lionfish. Lionfish hunting is an effective strategy for controlling the lionfish population within recreational diving limits; especially on oceanic islands with fringing reefs. Mangrove habitats are difficult ecosystems for lionfish hunting and new methods are needed to detect lionfish. Mangroves are important areas for juvenile reef fish and some species require mangroves in the juvenile stages. In freshwater ecosystems, environmental DNA (eDNA) techniques have become widely used due to their success in detecting target species, and recently eDNA techniques started being utilized in marine ecosystems. An important component for determining lionfish density in mangroves will be to determine the degradation rate of lionfish eDNA in the laboratory. To determine the average degradation time of lionfish eDNA, water samples from aquariums that held one lionfish for 24 h were sampled over nine days. Water was filtered to extract DNA from seawater samples. DNA was amplified, and gels were run using electrophoresis. The degradation rates determined using this technique will be used in parallel with another study in our laboratory to detect lionfish DNA on coral reefs where the exact location of the lionfish is known. This study will result in the ability to estimate the presence on lionfish within an important parameter; the rate of degradation and that will contribute to developing the technique required to determine locations of lionfish for removal.

Keywords: Lionfish, environmental DNA, eDNA, degradation

ADAPTATION AND RESILIENCE IN A CHANGING CLIMATE: CRYPTIC *SYMBIODINIUM* SP. IN FLORIDA'S PILLAR CORAL OFFER A GLIMMER OF HOPE

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Like many coral reefs worldwide, the Florida Reef Tract (FRT) experienced two consecutive hyperthermal bleaching events during the summers of 2014 and 2015. The iconic and unique pillar coral, *Dendrogyra cylindrus*, suffered severe bleaching throughout the 320 km FRT. While all D. cylindrus colonies bleached severely during summer 2014, one Upper Keys site appeared more resistance to bleaching during the 2015 event and returned to normal coloration more quickly than some sites in the Middle and Lower Keys. This pattern of resistance was linked to a shift of the dominant Symbiodinium species associated with *D. cylindrus*. Following the first bleaching event in September 2014, we observed a rapid change in dominance from the typically hosted *Symbiodinium* 'dendrogyrum' to the cryptic S. 'meandrinium', where the dominance of this latter persisted throughout the second bleaching event in August/September 2015 and through April 2016. The fine taxonomic resolution achieved in this study through the use high-throughput amplicon sequencing of the chloroplast 23S hypervariable region allowed the discovery of an ecologically relevant shift and a glimmer of hope for adaptation and resilience for corals in a changing climate.

Keywords: adaptation, *Dendrogyra cylindrus*, Florida Reef Tract, hyperthermal bleaching, pillar coral, resilience

CARBON SOURCES SUPPORTING FOOD CHAINS IN A MANGROVE FOREST AND ADJACENT INTERTIDAL MUDFLATS: A STABLE ISOTOPE TECHNIQUE FOR ASSESSING ECOSYSTEM CONNECTIVITY

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The abundance of food resources has been promoted as one of the principal attributes of mangroves and mudflats as nursery habitats for juvenile fish. Identifying the primary producers sustaining these food webs is the foundation for informed management plans to conserve biodiversity and commercial resources in a habitat mosaic. These habitats are also thought to be interlinked through diurnal or tidal fish migrations and carbon exchange. We use carbon and nitrogen stable isotope analysis (SIA) of primary producers, benthic and planktonic meiofauna, invertebrates, fishes and birds to identify the autotrophs underpinning food webs in a mangrove forest and adjacent intertidal mudflat in the Gulf of Paria, Trinidad and Tobago. We find isotopically distinct food webs in the two habitats, and even isotopic distinctions for the same species collected in both habitats. MixSIAR mixing models show that mangrove carbon does not support fish populations in an adjacent mudflat ecosystem and may only partially support fishes in mangroves along with other carbon sources. This reaffirms findings from previous studies that question the role of mangrove carbon in food webs and the 'outwelling' hypothesis. In both habitats, phytoplankton and/or benthic microalgae support foodwebs for fishes and waterfowl. We observed little evidence of connectivity between the two habitats in terms of carbon exchange and feeding migrations for several planktivorous and demersal fish species. We present the possible reasons for this habitat isolation and what it means for management of fish nursery habitats.

Keywords: mangrove, mudflat, fish, nursery, isotopes, food webs

IMPACT OF WATER TEMPERATURE INCREASE IN THE PHOTOSYNTHESIS AND CALCIFICATION/GROWTH RATE OF THREE LIFE STAGES OF *PORITES ASTREOIDES*

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A rise in sea surface temperature can affect corals physiological processes in different ways during each development stage. Here, we determine the impact of temperature increase on symbiont photosynthesis and growth/calcification of coral host in *Porites astreoides* at different developmental stages which include swimming larvae, newly settled juveniles and adults. Photosynthetic efficiency (Fv/Fm') of symbionts in adults and larvae were measured using a Diving PAM (Walz). Calcification rates of adults were measured using the buoyant weight technique, and the growth rates of the swimming larvae and newly settled juveniles were measured using light microscopy and Image J-Fiji software. The temperature treatments include 28°C, an intermediate mildly stressful temperature of 30°C, and a third treatments of 32°C which is the threshold for bleaching, Photosynthetic efficiency of the swimming larvae was not affected by temperature increase, meanwhile, newly settled juveniles exhibited more variation in Fv/Fm values. The adult stages showed a dramatic decrease in photosynthetic efficiency. No significant changes with increase in temperature were observed in growth rates for the swimming larvae and newly settled juveniles. However, the calcification rate of the adults slightly increased at higher temperature. Thus, the susceptibility to thermal stress varies depending on the life stage.

Keywords: *Porites astreoides*, temperature increase, photosynthesis, calcification, life stages

GRAZING BY GREEN TURTLES INDUCED A COMMUNITY SHIFT FROM CLIMAX TO EARLY SUCCESSIONAL SPECIES IN THE CARIBBEAN.

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In the Caribbean, Green turtles (*Chelonya mydas*) practice rotational grazing where *Thalassia testudinum* grazing patches are used for up to 2 years, after which these patches are abandoned. This study examined the effects of simulating grazing (clipping) by green turtles on both ungrazed and grazed abandoned seagrass patches during different periods. Treatments included 0 (control, no grazing), 4, and 8 months of simulating clipping, and treatments for grazed abandoned patches were 8 months of clipping and 8 months of recovery without clipping. Grazing resulted in a decrease in shoot density and below ground biomass for the preferred turtle food *T. testudinum*, while an increase in these parameters was observed for the faster growing seagrass *Syringodium filiforme*. By contrast, *T. testudinum* leaf length, leaf width, foliar shoot density, and biomass were negatively affected by the simulated grazing. As grazing time increased, *T. testudinum* leaf C/N-ratios decreased and ammonium pore water levels increased, suggesting a reduced demand for nitrogen by *T. testudinum*. Patches with 8 months of clipping after abandonment showed rhizome soluble carbohydrate content and leaf tannin concentration greatly reduced, suggesting a total depletion of energetic and carbon reserves. This latter was confirmed by an increase in carbohydrate reserves in *T. testudinum* from the abandoned patches that had recovered for 8 months. This time series showed that grazing on *T. testudinum* cause carbon depletion and increase the ammonia in the sediments. Ammonia is a resource available for the fast growing *S. filiforme*, causing a community shift from *T. testudinum* into *S. filiforme*.

En el Caribe la tortuga verde (*Chelonya mydas*) practica pastoreo rotacional en pastizales marinos dominados por *Thalassia testudinum*, manteniendo parcelas ramoneadas hasta por dos años que posteriormente son abandonadas. Este estudio analizó el efecto de la herbivoría por tortugas utilizando parcelas sin pastoreo y parcelas abandonadas de manera natural. Los tratamientos consistieron en diferentes niveles de intensidad de herbivoría (tiempo). En parcelas sin pastoreo previo se estableció el control (nivel 0), y dos niveles adicionales simulando el pastoreo de tortugas (clipping) durante 4 y 8 meses respectivamente. En parcelas abandonadas, se estableció un tratamiento con herbivoría artificial por 8 meses y uno más con 8 meses de recuperación (no herbivoría simulada). El pastoreo resultó en una disminución en la densidad de haces y biomasa subterránea para la especie preferida por las tortugas *T. testudinum*. Los mismos parámetros incrementaron para la especie de crecimiento rápido *Syringodium filiforme*. Al aumentar el tiempo de pastoreo, disminuyó la longitud, ancho y proporción de C/N en hojas de *T. testudinum*. En cambio la concentración de amonio incrementó en el agua intersticial del sedimento, que sugiere una disminución en la demanda de nitrógeno por *T. testudinum*. Las parcelas abandonadas y con pastoreo artificial por 8 meses, mostraron las menores

concentraciones de carbohidratos solubles en los rizomas y de contenido de taninos en hojas, como una posible causa de la reducción en sus reservas energéticas y de carbono. Esto concuerda con el aumento de carbohidratos solubles de *T. testudinum* en las parcelas abandonadas naturalmente pero con 8 meses de recuperación. Se sugiere que una pérdida en las reservas de carbohidratos solubles en los rizomas de *T. testudinum* y el aumento de amonio disponible en el sedimento, favorecen un cambio en la comunidad de pastos marinos hacia una mayor abundancia de especies de crecimiento rápido como *S. filiforme*.

Keywords*: Chelonya mydas*, seagrass, grazing, clipping, *Thalassia testudinum*, *Syringodium filiforme*

MARINE PROTECTED AREAS AND CORAL REEF RESILIENCY, CAYMAN ISLANDS

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Coral reefs in the Caribbean region have experienced widespread coral cover loss over the past 3 decades, primarily due to hurricanes, coral disease outbreaks, loss of "keystone" herbivores, coral bleaching, eutrophication and overfishing. Centrally located in the NW Caribbean, the Cayman Islands established a system of Marine protected areas in 1986. The current study aims to assess the benthic community composition at 40 sites around Grand Cayman, Little Cayman and Cayman Brac, for the years 2009, 2012, 2015 and 2016. Benthic community was analyzed and compared between MPAs and non-MPA areas across islands on their shallow and deep reef terrace reefs. Results revealed a low hard coral cover average across islands in 2009 of 9.5% and Macro-algae showing 79.44% cover to a much high coral cover average in 2016 of 21.7%, and a much lower macro algae cover of 42.2%. The remaining % benthic cover was composed of soft corals, crustose coralline algae, sand, rubble and dead corals. Comparisons between the three islands showed that the less developed Sister Islands had a higher coral cover compared to the more developed Grand Cayman. Additionally, the macro algal cover was higher in Grand Cayman and Cayman Brac. The two most abundant coral species within the waters of the Cayman Islands comprised the encrusting corals *Agaricia* and *Porites* spp. The high percentage cover of macro algae cover, which predominantly composed of *Dictyot*a and *Lobophora*. Analysis showed a higher species abundance along the southern coastlines and within the shallower reef systems. A temporal analysis demonstrated a significant increase in the cover of hard coral species across all the islands, with a net decrease in the macro algae cover. Following several bleaching and hurricane events during recent years, the Cayman Islands showed positive signs of recovery and suggest the presence of resilient reefs, especially within the MPAs.

Los arrecifes de coral en la región del Caribe han experimentado pérdidas generalizadas de cubierta coralina durante las últimas 3 décadas, principalmente debido a huracanes, brotes de enfermedades de coral, pérdida de herbívoros "clave", blanqueamiento de corales, eutrofización y sobrepesca. El presente estudio tiene como objetivo evaluar la composición de la comunidad bentónica en 40 sitios alrededor de Grand Caiman, Little Caiman y Caiman Brac, para los años 2009, 2012, 2015 y 2016. La comunidad bentónica fue analizada y comparada entre áreas protegidas marinas y áreas no protegidas a través de islas en sus arrecifes de arrecifes superficiales y profundos. Los resultados revelaron un promedio de cobertura de coral duro bajo en las islas en 2009 de 9.5% y Macroalgas mostrando un 79.44% cubriendo un promedio de cubierta de coral muy alto en 2016 de 21.7% y una cobertura de macro algas mucho más baja de 42.2%. El resto de la cubierta bentónica estaba compuesta por corales blandos, algas coralinas crustosas, arena, escombros y corales muertos. Las comparaciones entre las tres islas mostraron que las islas hermanas menos desarrolladas tenían una cubierta de coral más alta en comparación

con el Grand Caiman más desarrollado. Además, la cobertura macro algas fue mayor en Gran Caimán y Caiman Brac. Las dos especies de coral más abundantes dentro de las aguas de las Islas Caimán comprendían los incrustantes corales *Agaricia* y *Porites* spp. El alto porcentaje de cobertura de algas macro cubiertas, que se compone principalmente de *Dictyota* y *Lobophora*. El análisis mostró una mayor abundancia de especies a lo largo de las costas del sur y dentro de los sistemas de arrecifes menos profundos. Un análisis temporal demostró un aumento significativo en la cubierta de especies de corales duros en todas las islas, con una disminución neta en la cobertura de macroalgas. Después de varios episodios de blanqueo y huracán durante los últimos años, las Islas Caimán mostraron signos positivos de recuperación y sugieren la presencia de arrecifes resistentes, especialmente dentro de las MPAs.

Keywords: Marine protected areas, Cayman Islands, Coral reef resilience

CORAL BLEACHING IN THE MESOAMERICAN REGION (2015-2016)

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The Mesoamerican Reef extends for over 100km across the Caribbean coasts of Mexico, Belize, Guatemala and Honduras. It has experienced at least six bleaching events since the first recorded in 1995, including the 2015/2016 third global mass bleaching event, currently affecting reefs worldwide. In order to assess the extent of coral bleaching and its potential impacts in the Mesoamerican region (MAR), the Healthy Reefs Initiative led a regional Coral Bleaching Emergency Response Plan in partnership with 19 regional organizations. Surveyors quickly mobilized across the MAR region to monitor over 100 sites in October/November 2015 and again in 2016 assessing a total of 33,890 corals. Overall, the Mesoamerican Reef was moderately affected by this bleaching event, with 36% of corals “affected” in 2015 and 49% affected in 2016. Both years approximately half of the colonies were pale and half were either partly of fully bleached. The number of fully bleached corals increased from 3% to 5% from 2015 to 2016, while the partially bleached category increased from 15% to 20% of the colonies. Overall, Honduras was the most affected country (73%) followed by Mexico (47%) then Guatemala (33%) and Belize (23%). Some of the main reef building coral species were also the most severely bleached, in terms of percent of colonies partly or fully bleached, including *Orbicella franksii* (42%), O. annularis (34%) and *O. faveolata* (26%) and *Undaria tenuifolia* (35%). The two-year $40,000 project involved 23 sub-grants organized by the four HRI country coordinators and administered by the Mesoamerican Reef Fund, which is establishing an Emergency Response Fund that could assist with future events.

El Arrecife Mesoamericano se extiende por más de 100km a lo largo de las costas caribeñas de México, Belice, Guatemala y Honduras. Esta zona ha experimentado al menos seis episodios masivos de blanqueamiento de coral desde el primer registro en 1995, incluyendo el tercer evento global (2015/2016), que afecta actualmente a los arrecifes nivel global. Con el fin de evaluar el grado de blanqueamiento y sus posibles impactos en la región de Mesoamérica, la Iniciativa de Arrecifes Saludables (HRI) llevó a cabo un Plan Regional de Respuesta de Emergencia de Blanqueamiento de Coral en colaboración con 19 organizaciones regionales. Las organizaciones se movilizaron rápidamente en toda la región del Sistema Arrecifal Mesoamericano (SAM) para monitorear más de 100 sitios en octubre/noviembre de 2015 y de nuevo en 2016 evaluando un total de 33,890 corales. En general, el SAM fue moderadamente afectado por este evento de blanqueamiento, con el 36% de los corales "afectados" en 2015 y el 49% afectados en 2016. En ambos años aproximadamente la mitad de las colonias estaban pálidas y la mitad fueron parcialmente blanqueadas. El número de corales completamente blanqueados aumentó del 3% a 5% de 2015 a 2016,

mientras que la categoría parcialmente blanqueada aumentó de 15% a 20% de las colonias. En general, Honduras fue el país más afectado (73%), seguido por México (47%), Guatemala (33%) y Belice (23%). Algunas de las principales especies de corales que se fueron severamente blanqueadas, en términos de porcentaje de colonias parcialmente o totalmente blanqueadas, incluyen *Orbicella franksii* (42%), *O. annularis* (34%) y *O. faveolata* (26%) y Undaria tenuifolia (35%). El proyecto de dos años de $40,000 involucró 23 subsidios organizados por los cuatro coordinadores de países de HRI y administrados por el Fondo Arrecifal Mesoamericano, que está estableciendo un Fondo de Respuesta a Emergencias que podría financiar futuros eventos de blanqueamiento.

Keywords: coral reefs, bleaching index, Mesoamerican region, degree heating weeks

ON THE RELATIONSHIP BETWEEN PARTIAL MORTALITY AND THE DEMOGRAPHICS OF *ACROPORA CERVICORNIS*

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Understanding how coral populations respond to partial mortality of the colonies is essential to evaluate population persistence under unfavorable environmental conditions, such as elevated sea water temperature, high sedimentation rates, and strong wave surge due to storms. Coral species that contribute significantly to the structure and function of coral reefs are of interest. The aim of this study was to test the hypothesis that partial mortality sets back the demographic performance of the threatened reef-builder coral *Acropora cervicornis*. We followed, for two years, the fate (growth and survival) of colonies with varying degree of partial mortality indicated by tissue loss, at two reefs in Puerto Rico. Partial mortality limited colony growth and increased the odds of death. A simple stage-based matrix population model indicated that at an increasing number of colonies with more than 20% of partial mortality, the time to reach a quasi-extinction level (set at 25% of the original population size) was reduced considerably. Thus, the partial mortality of colonies should be taken into consideration when evaluating the population dynamics of *A. cervicornis*.

Keywords: *Acropora cervicornis*, partial mortality, extinction, colony conditions

MULTI-AGENCY RESCUE OF THE THREATENED PILLAR CORAL ALONG THE FLORIDA REEF TRACT

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Pillar coral (*Dendrogyra cylindrus*) is a rare but conspicuous Caribbean coral, and the only species in its genus. It was listed as threatened under the U.S. Endangered Species Act in 2014 by NOAA Fisheries due to a combination of threats including ocean warming, ocean acidification, and disease. Once a species is added to the Endangered Species List, NOAA Fisheries engages in planning and implementation of recovery actions to provide for the conservation of the species. In 2016, a severe mortality event, beginning in 2014, affecting the entire Florida population of pillar coral was reported. The dramatic decline prompted a multi-agency coordinated effort to "rescue" fragments of as may extant genotypes as possible to provide a genetic "Noah's Ark" as well as investigate viable restoration techniques. The high-level of collaboration and dedication by the partner agencies, catalyzed by the species' threatened status, is a success story despite the dire status of the Florida population.

Keywords: Threatened, Endangered Species Act, pillar coral, *Dendrogyra cylindrus*, restoration, Florida, disease.

COLLAPSE, RESCUE, AND POTENTIAL RESTORATION OF FLORIDA'S PILLAR CORAL *DENDROGYRA CYLUNDRUS.*

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The pillar coral *Dendrogyra cylindrus* has undergone a catastrophic 70% population decline on the Florida Reef Tract since 2014 due to back-to-back bleaching events and an expanding disease outbreak. The estimated number of surviving genotypes within the population has declined from 142 to 79, and the Florida inhabitants are assumed to be reproductively extinct and at high risk for regional extinction. In response to this decline, restoration efforts were rapidly scaled up from experimental microfragging and larval rearing trials to full-scale genetic banking. From an estimated 142 genotypes along the Florida Reef Tract, an estimated 70 have gone extinct. Of the remaining genotypes, 20% exist only within onshore conservation and research facilities. These facilities are researching disease treatment, fragmenting strategies, and methods to promote tissue growth. Juvenile settlement and growth of the species has also been achieved from wild-spawning parents. Partnerships between federal, state, academic, and non-profit agencies has allowed for the rapid response and care for this species to salvage what remains of the population for future restoration.

Keywords: Restoration, Disease, *Dendrogyra cylindrus* Spawning, Population, Coral, Florida

DEVELOPMENT OF A MOLECULAR ASSAY FOR CARIBBEAN CORAL IDENTIFICATION

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As coral cover has declined throughout the Caribbean, interest in determining the potential for reef recovery via natural recruitment processes has increased. Studies investigating recruitment processes have been hampered by the difficulty of identifying larvae or recently settled recruits that often lack distinguishing morphological characters. To overcome these constraints, the development of molecular tools to recognize species at early life stages are required. In this study, we investigated the utility of targeting the non-coding internal transcribed spacer (ITS) regions with a multiplex PCR assay to identify common Caribbean coral species. To design this assay, we developed a database of ITS sequences for 17 different Caribbean scleractinian coral species that are important reef builders, or are common. Analyzing the ITS region, we detected sufficient genetic variation to allow for potential differentiation of nine Caribbean coral species to the genus level, and eight to the species level. We subsequently designed a set of three genus-specific primers (with a total of seven included species) and six species-specific primers for use in a single-step nested multiplex PCR protocol that facilitates coral identification. We were unable to successfully design primers for five species that were included in the database. While still under development, this genetic assay shows significant promise as an inexpensive and relatively straightforward method of identifying planula larvae and recently settled coral recruits to the genus or species level. The increased accuracy and abbreviated timeframe offered by this technique for identifying larvae and recruits will be a valuable tool in evaluating Caribbean reef recovery moving forward.

Keywords: Corals, molecular assay, single-step nested multiplex PCR, internal transcribed spacer regions 1 and 2

SARGASSUM INFLUXES: UNDERSTANDING THE CAUSES AND CONSEQUENCES IN THE CARIBBEAN

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Since 2011, the Caribbean has been affected by periodic mass influxes of pelagic *Sargassum* seaweed. These events have resulted in mass inundating of coastlines, harbors, bays and beaches by the weed and significant disruption of the fisheries and tourism sectors across the region with social and economic consequences. There have also been negative impacts to sensitive coastal habitats and species produced by the decomposition of the algae. These events, which are unprecedented in the southern, central and eastern Caribbean as far back as records exist, have caused many misconceptions and confusion about the causes and sources of the massive *Sargassum* influxes to this region, raising questions about whether they represent a 'new norm' under the current climate change scenario. This presentation answers the call for better communication of the current scientific knowledge regarding *Sargassum* influxes and presents the progress with developing predictive models to provide early warning of future events. It also highlights the many areas in need of further research and monitoring.

Keywords: *Sargassum* influxes, Caribbean, Climate Change.

A NEW APPROACH TO UNDERSTANDING THE ETIOLOGY OF BLACK BAND DISEASE

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Black band disease (BBD), a globally distributed, cyanobacterial-dominated, polymicrobial disease of corals, has been studied using ecological and microbiological approaches since the 1970s. This body of work has led to many insights that include the physiological flexibility of BBD bacterial community members (photosynthetic, heterotrophic, lithotrophic); production of toxins (cyanotoxins and sulfide), including synergy between toxins; generation of oxygen/sulfide microenvironments; coral host susceptibilities; geographic distributions and patterns of disease spread; the existence of a temperature threshold; the presence of quorum sensing signaling systems; ultrastructural effects on host corals; and more. Similarly, many research groups have carried out sequencing studies targeting the 16S rRNA gene, which has led to a large data base of the diverse taxonomic identities of BBD community members. The most recent approach to studying BBD makes use of metagenomics, including metagenomes of the BBD consortium using BBD community DNA and metagenomes of cultures of the predominant BBD cyanobacteria. The latter includes genomes of associated bacteria that may or may not be symbiotic. Exciting new information derived from these new metagenomic analyses of BBD includes the finding of high numbers of CRISPR and Cas gene sequences, suggesting a completely unexplored role of viruses in this disease. This talk will discuss the ways in which the ecological/physiological/16S rRNA data bases can be used as a guide to mine the vast metagenomic data sets, and in turn how annotated sequences in the metagenomes can provide important clues to further explore BBD using microbiological/physiological approaches. This synergistic approach will most certainly lead to new laboratory-based studies such as assessing how viruses interact with BBD bacterial isolates.

Keywords: Black band disease, metagenomics, etiology, ecophysiology

NUTRIENT LOADING HINDERS MECHANISMS INVOLVED IN THE EPIGENETIC MAINTENANCE OF GENOME INTEGRITY IN THE STONY CORAL *ACROPORA CERVICORNIS*

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Coral reefs are particularly susceptible to the effects of global change, causing widespread coral bleaching and mortality. Nutrient pollution and increasing sea surface temperatures, two primary drivers of global change in the oceans, impact coral organismal physiology making predictions of coral survival very pessimistic. While multiple studies have addressed the physiological effects and ecological consequences of global change in corals, the molecular mechanisms underlying their acclimation responses to these stressors are still uncertain. Here, we aim to provide insights into how epigenetic modifications (responsible for phenotypic changes caused by heritable modifications in gene expression without changes in the DNA sequence) participate in coral acclimation responses during exposure to nutrient pollution. For that purpose, we combined field experiments in the Florida Keys with physiological and epigenetic analyses using the stony coral *Acropora cervicornis* as model system. Accordingly, coral fragments were exposed to different levels of nitrogen and phosphorous enrichment for 5 weeks in the field (Pickles Reef, Key Largo, FL). Coral samples were collected at different time intervals during experiments and subsequently analyzed for nutrient content and epigenetic modifications (DNA methylation and histone modifications). Our results revealed rapid changes in total DNA methylation levels in response to nutrient loading, along with increased symbiont densities, likely increasing ROS and oxidative stress. Yet, qPCR and ELISA experiments revealed a decrease in histone H2A.X gene expression and S139 phosphorylation (involved in DNA repair). These results are consistent with the notion suggesting that phosphorous starvation caused by nitrogen enrichment will limit coral capacity to repair DNA based on histone H2A.X phosphorylation, increasing coral susceptibility to bleaching and disease.

Keywords: histone variants, corals, DNA methylation, phosphorus starvation, acclimation, global change

EFFECTS OF SUBMARINE GROUNDWATER DISCHARGES ON BENTHIC COVER AND REEF RUGOSITY IN PUERTO MORELOS, QUINTANA ROO Rosado-Torres, Arlett, Mariño-Tapia, Ismael, Acevedo-Ramírez, César

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In the Caribbean, most coral reefs have undergone a phase shift from coral to macroalgae-dominated benthic communities, which reduces the available substrate for coral recruitment, affecting its survival, distribution and, eventually, the structural complexity of the system. The change in structural complexity (decreasing rugosity) generates significant losses of ecosystem services (e.g. coastal protection and shelter of species). The causes of phase shift are multiple; however, recent studies suggest that continental water input can contribute significantly. The present study shows evidence of these inputs flowing directly into the reef crest, through submarine groundwater discharges (SGDs), and its effect on the ecosystem in Puerto Morelos, Q. Roo. Using oceanographic instrumentation, high resolution bathymetric profiles (DGPS + Echosounder) were obtained to characterize reef rugosity, videotransects to estimate benthic cover to morpho-functional groups (scleractinian corals, octocorals, sponges, macroalgae, seagrass, substrate), and salinity, temperature and nitrate measurements (CTD + SUNA) to determine the influence of SGDs. Water samples were taken to complete and calibrate SUNA information. In addition, instruments (ADCPs + CTDs) were installed fixed on the sea bottom, to study the dispersion of SGDs on the reef and its lagoon. Measurements show consistent decrements of salinity with one month duration (during October-November 2016) reaching minimum values of 15 psu at sites influenced by SGDs. These sites show contrasting effects as compared to the reference sites (i.e. Limones), such as a macroalgae-dominated benthic cover, and reduced rugosity, especially where the algae are present. Evidence of this is observed in the rugosity index obtained for the reference profile and for at least four profiles along the lagoon. The results corroborate the negative influence of SGDs by reducing reef rugosity on the reef, which reduces numbers of habitats, potential for recover and enforces the demand for better sewage treatment practices in the area.

En el Caribe, la mayoría de los arrecifes han sufrido un cambio de fase, que ocurre cuando la cobertura escleractínea es disminuida en favor de una dominancia de macroalgas. Esto reduce el sustrato disponible para el reclutamiento del coral, afectando su supervivencia, distribución y, eventualmente, la complejidad estructural del sistema. El cambio en la complejidad estructural (decremento de rugosidad) genera pérdidas de servicios ecosistémicos (e.g. protección costera y refugio de especies). Las causas del cambio de fase son múltiples, sin embargo, recientes estudios sugieren que aportes continentales contribuyen significativamente. El presente estudio presenta evidencias en Puerto Morelos, Q. Roo de aportes de agua continental que desembocan en la cresta arrecifal, a través de descargas submarinas del acuífero (DSA), y su efecto en el ecosistema. Utilizando instrumentación oceanográfica se obtuvieron perfiles batimétricos de alta resolución (GPSd+Ecosonda) para caracterizar rugosidad arrecifal, videotransectos para estimar cobertura bentónica hasta grupos morfofuncionales (corales

escleractíneos, octocorales, esponjas, macroalgas, pastos marinos y sustrato), y mediciones de salinidad, temperatura y nitratos (CTD+SUNA) para determinar influencia de agua continental. Se tomaron muestras de agua para complementar y calibrar la información del SUNA. Adicionalmente se instalaron anclajes (ADCPs+CTDs) para estudiar la dispersión del agua continental en el arrecife y la laguna arrecifal. Disminuciones de salinidad durante un mes (Octubre 2016) y valores mínimos de 15 ups, se observaron en los sitios influenciados por DSAs. Estos sitios muestran efectos contrastantes comparados con sitios de referencia (Limones), como la composición del bentos que está dominada por macroalgas y rugosidad reducida, especialmente donde las algas están presentes. Evidencia de esto se observa en el índice de rugosidad obtenido para el perfil de referencia y por lo menos para otros cuatro a lo largo de la laguna. Los resultados corroboran la influencia negativa de las DSA en el arrecife, esto podría fortalecer la demanda por mejores prácticas de tratamiento de aguas residuales en la zona.

Keywords: Submarine Groundwater Discharges, Coral Reef, Roughness

LONG-TERM COASTAL EXPLOITATION AT HOLBOX ISLAND, MÉXICO.

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This study documents the history of fishing at Holbox Island through an interdisciplinary approach that integrates ecological, historical, archaeological, and fishers' traditional knowledge. The aim was to determine how small-scale fishing activities have contributed to declines in coastal resources and their near shore environments. Throughout 2016, we conducted 13 open interviews and 65 systematic surveys of fishers' perspectives on fisheries overexploitation, fishing practices, and knowledge of fishing sites. Survey results coupled with historical and archaeozoological data from excavations at the Mayan coastal site of Vista Alegre allow the construction of maps with baseline information long-term coastal exploitation. Preliminary results identify over 90 near shore fishing sites that were once very productive, including 40 highly species (i.e. Carcharhinidae, Lamnidae, Shpyrnidae, Pristidae, Cheloniidae) over the past 40 years. Additional data from archaeozoological remains (n= 545) of aquatic fauna identified 33 families of exploited taxa, of which finfish (i.e. Haemulidaea, Ariidae, Serranidae), sharks (i.e. Carcharhinidae), and sea turtles, were the most abundant. Fishers' and literature sources (n= 50) report increasing fishing effort through the mid 20th century, overfishing of higher trophic level fish, and contemporary illegal fishing in lagoonal sites. Combining these types of data (fishers' perspectives, interdisciplinary literature, historical and archaeozoological data), using historical ecology techniques and geospatial tools, we are generating novel baseline information on coastal development activities that is essential for understanding the conservation needs of the Island's natural and social resources.

El conocimiento tradicional de la pesca relacionado a biodiversidad de recursos pesqueros y los cambios de estos a través del tiempo se ha convertido en un tema relevante a nivel mundial. La documentación de dicho conocimiento es el objetivo de este estudio el cual documenta la explotación costera de la región, así como los cambios en la biodiversidad de recursos pesqueros y distribución de hábitats de pesca. Se empleó un enfoque interdisciplinario (biología marina, arqueología, geografía, historia ecológica), que incluyo la colaboración de pescadores y miembros de la comunidad de Isla Holbox y Chiquilá. Se realizaron entrevistas abiertas (n=13) y encuestas sistemáticas (n=65) relacionadas con la percepción de los pescadores respecto a la explotación y prácticas pesqueras, así como de los sitios tradicionales de pesca. Los resultados de las encuestas

se integraron con datos históricos y arqueológicos del sitio prehispánico de Vista Alegre para la elaboración de mapas con información de línea base que describen la explotación pesquera en Holbox. Resultados preliminares muestran más de 90 sitios de pesca que han sido históricamente productivos para la pesca artesanal con más de 40 especies explotadas en los últimos 40 años. Los restos arqueológicos (n=545) muestran la explotación de peces óseos, tiburones y tortugas. La información de los pescadores y datos literarios señalan una intensificación de presión pesquera en la segunda mitad del siglo XX, con mayor impacto en peces con mayor nivel trófico (e.g. chernas, meros). Además, se documentó que la pesca ilegal es común en la laguna de Yalahau. La información obtenida proporciona una visión integral de los hábitats y recursos explotados en la isla a través del tiempo. Esta información constituye una línea base de los recursos pesqueros en Isla Holbox, que puede ayudar para la generación de estrategias de manejo que favorezcan la preservación del capital natural y social de la Isla.

Keywords: Holbox Island, coastal exploitation, traditional knowledge, interdisciplinary science

SEAGRASSES OF COSTA RICA: FROM THE MIGHTY CARIBBEAN TO THE DYNAMIC MEADOWS OF THE EASTERN TROPICAL PACIFIC

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Seagrass meadows are declining worldwide, mostly due to anthropogenic disturbances. In face of this decline it is urgent to understand the dynamics of these meadows in order to establish adequate management and conservation strategies. Here, we analyzed the current knowledge on the seagrass meadows in the Caribbean and Pacific coasts of Costa Rica, Central America. Current knowledge was based on literature searches, herbarium collections and informal interviews. We report a total of five genera and seven species for Costa Rica: *Thalassia testudinum*, *Syringodium filiforme*, *Halophila decipiens*, *Halophila baillonis*, *Halodule wrightii*, *Halodule beaudettei*, and *Ruppia maritima*. Six species are reported for the Caribbean, and four species for the Pacific. *T. testudinum*, *S. filiforme*, and *H. decipiens* have only been reported for the Caribbean. *H. beaudettei* has only been reported for the Pacific coast. *H. baillonis*, *H. wrightii* and *R. maritima* have been reported for both coasts. Seagrasses were found at a total of 30 locations in Costa Rica; the majority from the Pacific coast, of which 15 are first reports. Seagrass meadows from both coasts are vastly different. Along the Caribbean coast, meadows are often dominated by the robust *T. testudinum*, which are extensive and stable, persisting for decades. In contrast, the meadows along the Pacific coast are more dynamic and are dominated by pioneer and ephemeral species, such as *H. baillonis* and *H. beaudettei*. The number of studies on Costa Rican seagrasses is scarce but has been increasing over time, mostly concerning taxonomy, and the dynamics of the seagrass *T. testudinum* from the Caribbean. Conservation and management efforts on Costa Rican seagrass meadows would benefit from continued monitoring and research on ecosystem resilience and services, incorporating associated fauna and flora.

Las praderas de pasto marino están deteriorándose a nivel mundial, ligado a disturbios antropogénicos. Esta degradación resalta la necesidad de entender las dinámicas ecológicas de estos sistemas costeros para definir estrategias de manejo y conservación adecuadas. Aquí, nosotros analizamos el conocimiento actual sobre praderas de pastos marinos en las costas Caribe y Pacífico de Costa Rica. El conocimiento actual se basó en revisiones de literatura, colecciones de herbarios y entrevistas. Reportamos un total de cinco géneros y siete especies para Costa Rica: *Thalassia testudinum, Syringodium filiforme, Halophila decipiens, Halophila baillonis, Halodule wrightii, Halodule beaudettei y Ruppia maritima*. Se reportan seis especies para el Caribe y cuatro especies para el Pacífico. *Thalassia testudinum, S. filiforme y H. decipiens* solamente han sido reportadas para el Caribe. Halodule beaudettei está solamente en la costa Pacífica. *Halophila baillonis, H. wrightii* y *R. maritima* son reportadas para ambas costas. Se encontraron pastos marinos en un total de 30 sitios en Costa Rica, la mayoría en el Pacífico; 15 de los cuales se reportan aquí por primera vez. Las praderas de pastos marinos de ambas costas son sumamente diferentes. En el Caribe, hay praderas extensas

dominadas por una especie grande, *T. testudinum*, las cuales han estado presentes por décadas. En contraste, las praderas en la costa Pacífica son más dinámicas ya que están dominadas por especies pioneras y efímeras, principalmente *H. baillonis y H. beaudettei.* El número de estudios sobre pastos marinos en Costa Rica es limitado, pero ha estado creciendo de manera constante, enfocándose principalmente en reportes taxonómicos y ecología de *T. testudinum* en la costa Caribe. Esfuerzos de investigación, conservación y de manejo se verían beneficiados por una continuación del monitoreo e investigación detallada en pastos marinos, pero también en la resiliencia del ecosistema y su
s servicios, incorporando la flora y fauna asociada.

Keywords: Seagrass meadows, coastal wetlands, Eastern Tropical Pacific, Caribbean, Central America, inventory

ACROPORA SPP. RESTORATION EFFECTS ON REEF COMMUNITY RESPONSE IN THE CARIBBEAN

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Coral reef ecosystems are home to ecologically and commercially important species that allow for essential ecosystem services to coastal communities such as coastal protection, food, and tourism. Unfortunately, there has been a worldwide decline in coral cover due to unsustainable human activity. As a response to reef loss, the active supplementation of a coral population unto the reef (outplanting) is currently the most important conservation strategy. In the Caribbean, however, proper assessments of the reef community's response to coral outplants are rare or non-existent. Thus, the purpose of our study is to: Evaluate the recovery of several important species and ecosystem function across outplanting sites that have been subject to differing levels of *Acropora* spp. outplanting efforts in the Caribbean. We used a 30m transect to document the benthic community composition every 20cm and measured every hermatypic coral that intercepted the line in restored reefs and non-restored reefs at six sites in the Caribbean (Guana Island, St. Croix, Dominican Republic, Bahamas, Jamaica, and Belize). We assessed fish diversity by surveying along the transect line with a span of 0.75m to each side. Results show significant difference in Acropora cervicornis densities ($p<0.034$) across restored and unrestored sites suggesting restoration success of the focal species. There was a non-significant trend between species densities and functional groups across treatments, with higher densities in restored sites. These results suggest that ecosystem recovery may: 1. Increase over time with a persisting A. cervicornis population survivorship, 2. Require higher restoration effort, and 3. Require new restoration approaches (i.e. multi-species restoration).

Keywords: *Acropora cervicornis*, coral restoration, ecosystem function

COMMUNITY-BASED SCIENTIFIC CITIZENS: A STRATEGY TO MANAGE COASTAL RESOURCES IN RESPONSE TO THE EFFECTS OF CLIMATE CHANGE

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Given the demand and misuse of natural resources our ecosystems have lost the ability to self-support. Climate change has rise global and regional issues, most alarming to coastal communities are the shoreline erosion and sea level rise. With over 435 Kilometer of coastline on 44 municipalities (57%) in Puerto Rico many hotels, residences and business are in threat. To protect our coastal resources is necessary to improve the understanding and management of them by the scientific and general community. By sharing scientific information with coastal communities will benefit the ecosystems to be restored to their functional state, where they can recreate a sustainable resource cycle. The non-governmental organization Sociedad Ambiente Marino (SAM) has a history of more than two decades of implementation of social strategies in coastal communities while empowering volunteers with skills and knowledge providing them with solid tools to fulfill their purpose in the conservation of the coastline with healthy coral reefs. The preoccupation, concern about the coastal erosion and sea level rise, plus the interest, love and passion for the sea, shared by these volunteers are great sources of motivation to protect their backyard. This symbiosis of ecological knowledge and socio participation has provided the SAM with relevant information for future studies and has been the source of information for over 100 presentations in more than 14 international scientific meetings, generating over 25 publications in scientific peer reviewed journals. With the collaboration of the scientific citizens volunteers, the SAM will continue to change paradigms and promote knowledge with the firm intention to accomplish the recovery, conservation and sustainability of coral reefs protecting our coasts.

Dada la demanda y el mal uso de los recursos naturales, nuestros ecosistemas han perdido la capacidad de autosuficiencia. El cambio climático ha aumentado los problemas mundiales y regionales, lo más alarmante para las comunidades costeras son la erosión de las costas y el aumento del nivel del mar. Con más de 435 Kilómetros de costa en 44 municipios (57%) en Puerto Rico muchos hoteles, residencias y negocios están en peligro. Para proteger nuestros recursos costeros es necesario mejorar la comprensión y el manejo de los mismos por la comunidad científica y general. Al compartir información científica con las comunidades costeras, los ecosistemas se beneficiarán para restaurar su estado funcional, donde pueden recrear un ciclo sostenible de recursos. La organización no gubernamental Sociedad Ambiente Marino (SAM) tiene más de dos décadas de implementación de estrategias sociales en las comunidades costeras, al mismo tiempo que habilita a los voluntarios con habilidades y conocimientos que les proporcionan herramientas sólidas para cumplir con su propósito en la conservación de la costa con arrecifes de coral. La preocupación, e inquietud por la erosión costera y la elevación del nivel del mar, más el interés, el amor y la pasión por el mar, compartida por estos voluntarios son grandes fuentes de motivación para proteger su patio trasero. Esta simbiosis de conocimiento ecológico y participación social ha proporcionado a la SAM

información relevante para futuros estudios y ha sido fuente de información para más de 100 presentaciones en más de 14 reuniones científicas internacionales, generando más de 25 publicaciones en revistas científicas revisadas por pares. Con la colaboración de voluntarios científicos, la SAM continuará cambiando paradigmas y promoviendo conocimiento con la firme intención de realizar la recuperación, conservación y sostenibilidad de los arrecifes coralinos que protegen nuestras costas.

Keywords: Scientific Citizens, Volunteers, Climate change, NGO, Coastal Communities, Sustainability

GIANT BARREL SPONGES, *XESTOSPONGIA MUTA*, ARE DOMINANT STRUCTURES ON A CARIBBEAN REEF.

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Coral reefs have been increasingly impacted by anthropogenic disturbances over the last half century threatening global biodiversity, ecosystem function, and the livelihoods of millions of people from mostly coastal resource-dependent communities. Specifically, Caribbean reefs have experienced mass disease-induced mortality of the herbivorous urchin *Diadema antillarum* and structurally dominant branching *Acropora* spp. corals as well as systemic overfishing, chronic nutrient enrichment and a series of coral bleaching events. Declining reef health here has largely been characterized by deterioration in hard coral cover and a phase shift to macroalgal cover. However, sponges are also a dominant component of Caribbean reef benthos and play critical roles in the ecological functioning of such communities, including the provision of habitat, food, and biogeochemical cycling, as well as acting as bio-eroders and competitors for space. Especially with the losses in coral cover, the present conditions on many reefs are suitable for sponge growth and proliferation. The giant barrel sponge, *Xetospongia muta*, is the largest, most conspicuous, longest-lived and second highest occurring sponge species on Caribbean reefs and has been noted to be expanding significantly in some areas. In this pilot study we examine the population size structure, density and cover of the giant barrel sponge on a single reef at Glover's Atoll, Belize. The observed dominance of *X. muta* at the study site may have serious implications for a number of ecosystem functions. As such, *X. muta* would be important to monitor as part of expanded benthic surveys that include many of the most frequently occurring sponge species. The monitoring and conservation of spongivorous vertebrate species (e.g. angelfishes, marine turtles) will also be a critical component of future reef management objectives as the environment for calcifying organisms, including hard corals, becomes increasingly challenging in light of climate change and associated ocean acidification.

Los arrecifes de coral han sido cada vez más afectados por disturbios antropogénicos durante el último medio siglo que amenazan la biodiversidad global, la función de los ecosistemas y los medios de vida de millones de personas procedentes en su mayoría de comunidades dependientes de recursos costeros. Específicamente, los arrecifes caribeños han experimentado la mortalidad masiva inducida por la enfermedad del erizo herbívoro Diadema antillarum y la ramificación estructuralmente dominante Acropora spp. Corales, así como sobrepesca sistémica, enriquecimiento crónico de nutrientes y una serie de eventos de blanqueamiento de corales. La disminución de la salud de los arrecifes aquí se ha caracterizado en gran parte por el deterioro de la cubierta de coral duro y un cambio de fase hacia la cobertura de macroalgas. Sin embargo, las esponjas son también un componente dominante del bentos boreal del Caribe y juegan papeles críticos en el funcionamiento ecológico de tales comunidades, incluyendo el abastecimiento del habitat, del alimento, y del ciclo biogeoquímico, así como del bio-eroders y de los competidores para el espacio. Especialmente con las pérdidas en la cubierta coralina, las

condiciones presentes en muchos arrecifes son adecuadas para el crecimiento y la proliferación de la esponja. La esponja de barril gigante, X. muta, es la especie de esponja más grande, más conspicua, de mayor longevidad y la segunda de mayor importancia en los arrecifes del Caribe, y se ha observado que se está expandiendo significativamente en algunas áreas. En este estudio piloto examinamos la estructura del tamaño de la población, la densidad y la cobertura de la esponja de barril gigante en un solo arrecife en Glover's Atoll, Belice. La dominancia observada de X. muta en el sitio del estudio puede tener serias implicaciones para una serie de funciones del ecosistema. Como tal, X. muta sería importante para monitorear como parte de las prospecciones ben tónicas expandidas que incluyen muchas de las especies de esponjas más frecuentes.El monitoreo y conservación de las especies de vertebrados esponjosos (por ejemplo, peces ángel, tortugas marinas) también será un componente crítico de los futuros objetivos de manejo de los arrecifes, ya que el ambiente para calcificar organismos, incluyendo corales duros, se vuelve cada vez más difícil a la luz del cambio climático y la acidificación asociada de los océanos.

Keywords: sponges, structure, population, community, ecosystem function, phase shift

A HISTOPATHOLOGICAL SURVEY OF QUEEN CONCH, *LOBATUS GIGAS*, HEALTH IN ST KITTS

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Queen conch, *Lobatus gigas*, sustains one of the largest commercial fisheries in the Caribbean. However, concerns over sustainable fishing have arisen since the collapse of stocks due to overharvesting. *L. gigas* populations are not replenishing as anticipated despite fishing restrictions and international conservation initiatives. Depleted and fragmented populations are at high risk of stochastic events such as disease epidemics; however, there is a paucity of literature regarding queen conch disease and the few reports of pathology did not use histological techniques. A histopathological survey was conducted to assess the health status of St Kitts queen conch populations. A standard dissection and sampling protocol was established and used to facilitate identification and description of pathology in sixty-one conch specimens sampled randomly/haphazardly? from fishermen at St Kitts. Pathology was observed in 13% (8/61) of the sampled population. Pathology mostly comprised internal parasitism (n = 5), especially encysted metazoan parasites, which were observed in the gill, digestive gland and large intestine, and likely comprise digenean metacercaria. Parasitism appeared to have little impact on the hosts' health and response to the infection was minimal. There were three cases of mild focal inflammation of unknown etiology in the mantle and gonadal tissues. Two cases of a congested and prolapsed anus were also seen but thought to be related to handling and extraction from shell. Disease appears to be uncommon in *L. gigas* caught by fisherman at St. Kitts. Pathologies observed elsewhere, such as imposex or apicomplexan infection of the digestive gland, could not be substantiated in our study population. High predation rate on diseased queen conch may yield underrepresentation of pathology. Future disease surveys could target stunted individuals, or those showing unusual behavior.

Keywords: gastropod pathology disease parasitism

COMPARISON OF CHEMICAL COMPOUNDS ASSOCIATED WITH SCLERITES FROM HEALTHY AND DISEAED SEA FAN CORALS (*GORGONIA VENTALINA*)

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The roles of gorgonian sclerites as structural components and predator deterrents have been widely studied. Yet, their role as barriers against microbes has only recently been investigated, and even less is known about the diversity and roles of the chemical compounds and mineral composition associated with the sclerites. Here, we examine the volatile organic compound fraction (VOCs) associated with sclerites from healthy and diseased Gorgonia ventalina sea fan corals to understand their possible role as a stress response or in defense of infection. We identified those chemical compounds that are present in sclerites, measured the oxidative potential of these compounds, and analyzed the mineral composition sclerites from diseased and healthy G. ventalina colonies. The results showed that sclerites harbor a great diversity of VOCs. Overall, 70 compounds were identified, the majority of which are novel with unknown biological roles. The majority of VOCs identified exhibit multiple immune-related roles including antimicrobial, antifungal and radical scavenging functions. The free radical activity assays further confirmed the anti-oxidative potential of some these compounds. The anti-oxidative activity was, nonetheless, similar across sclerites regardless of the health condition of the colony, although sclerites from diseased sea fans display slightly higher anti-oxidative activity than the healthy ones. No differences in the mineral composition were detected regardless of the health state of the corals suggesting that the health state of the corals have intangible effects on the mineralization of the sclerites.

Keywords: sea fans, arpergillosis, chemical defenses

HABITAT SUITABILITY FOR SEA TURTLES IN THE GULF OF MEXICO: A FUTURE SCENARIO

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Marine turtles are highly vulnerable species to variations in environmental temperature, having effects on their physiology, behavior, and even on their spatial and temporal distribution. It is reported that the shifting of temperate masses of water towards poles has caused the change of the distribution range of some of these species and the alteration of their feeding habitats. Five of the six marine turtle species inhabit the Gulf of Mexico (GoM), where they find critical habitats to complete their life cycle, and for which it has been projected sea surface temperature variations of up to 6°C. Despite the high influence of temperature on marine turtles, evaluations of changes in their range of distribution caused by climate change are scarce, and one approach to do it is using models based on the niche theory. The objective of this study was to evaluate projections of the geographical distribution for the five marine turtle species in year 2100 using habitat suitability models in the GoM in a SRES B1 climate change scenario. The nowadays and future geographical distributions for the five species that inhabit the GoM were obtained. It was observed that these species use different geographical and environmental spaces, and under a climate change scenario, the habitat suitability drastically diminishes in the most of the present suitable areas. The most affected species was *Dermochelys coriacea*, followed by *Chelonia mydas*, which lost large present suitable areas. This study gives a scenario of the climate change impacts on the distribution of marine turtles in the region of Gulf of Mexico.

Las tortugas marinas son altamente vulnerables a variaciones en la temperatura ambiental, con repercusiones en su fisiología, comportamiento e incluso distribución espacial y temporal. Se ha documentado que debido al corrimiento de las masas de agua templada hacia zonas polares algunas especies han incluso variado su rango de distribución y modificado sus hábitats de alimentación. En el Golfo de México habitan cinco de las seis especies de tortugas marinas; donde encuentran los hábitats críticos para completar su ciclo de vida; áreas en las que, en un escenario conservador de cambio climático, se esperan variaciones de hasta 6°C en la temperatura superficial marina. A pesar de la influencia de la temperatura en las tortugas, son escasas las evaluaciones de cambios en sus rangos de distribución por efectos del cambio climático, y una aproximación utilizada para tales estudiosos a través de modelos basados en la teoría del nicho ecológico. El objetivo de este trabajo fue evaluar las proyecciones para el año 2100 de la distribución geográfica de las tortugas marinas utilizando modelos de idoneidad ambiental en el Golfo de México ante el escenario SRES B1 de cambio climático. Se obtuvieron los modelos y las distribuciones geográficas actuales y futuras para las cinco especies de tortugas

marinas que habitan en la región. Se observó que estas especies utilizan espacios ambientales y geográficos diferentes y que, en un escenario de cambio climático, la probabilidad de idoneidad de sus hábitats disminuye drásticamente en la mayor parte de las áreas que actualmente son idóneas. La especie más afectada sería la *Dermochelys coriacea*, seguida de la Chelonia mydas que presentan la pérdida de grandes espacios idóneos actuales. Con este trabajo se provee un escenario de los impactos del cambio climático en la distribución de las tortugas marinas dentro de la región del Golfo de México.

Keywords: Spatial distribution, Niche ecology, Sea surface temperature, Climate change

EVIDENCE OF STRONG DENSITY-DEPENDENT LOSSES SOON AFTER SETTLEMENT FOR SPARISOMA PARROTFISHES ALONG THE WEST COAST OF BARBADOS

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Parrotfishes help sustain coral reef fisheries in many locations across the Caribbean and perform key ecological functions on the reefs. Whereas there has been considerable research focusing on parrotfish biology and ecology, we know little about the factors influencing parrotfish distribution and abundance soon after settlement, a critical period in the life history of reef fishes. In this study, we periodically monitored the distribution and abundance of recently settled *Sparisoma* (size range: 1-5 cm SL) on permanent quadrats deployed on three reefs along the west coast of Barbados, following a settlement peak. We used these data to (1) examine microhabitat associations of different size classes of *Sparisoma*; (2) examine spatial variability in density-independent and –dependent post-settlement losses in recently settled *Sparisoma;* and (3) investigate potential associations between post-settlement *Sparisoma* losses and microhabitat features. We found significant evidence of (1) a microhabitat use shift from dead coral covered by turf algae to dead coral covered by encrusting coraline algae within the smallest *Sparisoma* size classes (<2cm SL); (2) strong (and spatially variable) density-dependent *Sparisoma* losses soon after settlement, which ultimately distorted *Sparisoma* abundance patterns originally established at settlement, and (3) associations between the strength of density-dependent Sparisoma losses and certain microhabitat features. Overall, these results indicate that *Sparisoma* populations along the west coast of Barbados might suffer a population bottleneck driven by the availability of suitable early post-settlement microhabitat.

Keywords: *Sparisoma*; parrotfishes; density-dependence; microhabitat use;

SEVERE IMPACTS OF *SARGASSUM* SPP. BROWN TIDES ON NEAR-SHORE SEAGRASS COMMUNITIES IN THE CARIBBEAN

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From 2011 until 2016, unprecedented masses of pelagic seaweed *Sargassum* spp. were reported throughout the Caribbean and along the west coast of tropical Africa. The Mexican Caribbean coast experienced a massive influx of *Sargassum* spp. from mid-2014 until the end of 2015. These masses accumulated on the shores, resulting in build-up of decaying beach-cast material and near-shore murky brown water. We named this phenomenon *Sargassum*-brown-tide (Sbt). The effects of Sbt on four near-shore seagrass meadows included reduction in light, oxygen (hypoxia or anoxia) and pH, and increased temperature and ammonia concentration. The monthly influx of nitrogen by drifting *Sargassum* spp. was estimated at 6150 kg km-^{1}, and for phosphorus this was 61 kg km-^{1}, which were respectively, ~30 and ~3 -10 times the usual monthly inputs into the sea through ground-water discharge. Near-shore seagrass meadows dominated by *Thalassia testudinum* were replaced by a community dominated by calcareous rhizophytic algae and drifting algae and/or epiphytes, resulting in 61.6 to 99.5% loss of below-ground biomass. Near-shore corals suffered total or partial mortality. Recovery of affected seagrass meadows is likely to take years or decades or changes could be permanent if massive influxes of *Sargassum* spp. recur. If recurring at intervals of years or decades, the system will change permanently, resulting in increased eutrophication and loss of the ecosystem services provided by the near-shore seagrass meadows, such as facilitating biodiversity, increasing water transparency and beach stabilization.

Keywords: *Sargassum*, Algal-bloom Anoxia, Seagrasses, Corals

RECOMMENDATIONS AND OUTCOMES FROM THE NOVEMBER 2016 WORKSHOP TO ADVANCE THE SCIENCE AND PRACTICE OF CARIBBEAN CORAL RESTORATION

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In November 2016, NOAA convened a Workshop to Advance the Science and Practice of Caribbean Coral Restoration occurred in Fort Lauderdale, Florida. The workshop fostered collaboration and technology transfer among coral restoration scientists, practitioners, and managers from 20 Caribbean nations, and initiated a community of practice that will continue to address the multiple, rapidly expanding and evolving paths to active coral restoration in the evolutionary history of coral reef ecosystems. The theme of scaling up restoration to meet the needs of ecosystem recovery was woven throughout sessions on coral genetics, improving outplanting techniques, updates on the role of larval propagation, restoration of non-acroporid species, monitoring to quantify restoration success at multiple scales, and more. Five recommendations emerged from the workshop (1) restore reefs in targeted geographic areas to decrease coastal wave propagation and flood-risk (2) dramatically increase the efficiency and scale of restoration in order to establish self-sustaining, sexually reproductive populations (3) develop monitoring guidelines that cover both basic and detailed levels of information and share data to facilitate regional understanding of ecosystem status (4) develop guidelines on several issues related to coral genetics (5) form a Coral Restoration Consortium to facilitate ongoing communication and progress. Highlights from the workshop will be presented along with the vision and structure of the consortium that is currently being formed.

Keywords: restoration, coral, Outplanting techniques

HOW DOES COLONY SIZE AND DENSITY INFLUENCE PATERNITY IN A BROODING CORAL?

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Multiple natural and anthropogenic stressors have caused a decline in coral populations. Broadcast spawning corals once dominated the Florida Reef Tract (FRT), but since their decline, smaller brooding corals, soft corals, and macroalgae are replacing them. Brooding corals are more resilient to current threats in part because they are reproductive throughout much of the year and their larvae are competent to settle after release. Despite the ubiquity of brooders on Florida reefs, much of their reproductive strategy remains unknown. This study examines paternity as a function of colony size and density in *Porites astreoides*, a common brooding coral in the FRT. A focal colony of *P. astreoides* was surrounded by six other colonies, separated from the focal colony at different distances (1m, 7m, and 15m) representing high, moderate, and low population densities, respectively. Each array was replicated three times. Colonies were transported to the laboratory for larval collection and the resulting larvae were genotyped using eight microsatellite markers. Over a four day period, a total of 3,184 larvae were collected from 22 colonies, 13 of which released larvae over consecutive days. Understanding the paternity in common brooding corals is important to effectively assess and conserve Florida's shifting coral reef communities.

Keywords: coral, genetics, larvae, paternity, Porites

OCTOCORAL DISEASES IN A CHANGING OCEAN

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Octocorals (Cnidaria, Octocorallia) constitute a geographically and bathymetrically widely distributed and common group of marine invertebrates commonly referred to as soft-corals, gorgonians and sea plumes.. Octocorals are important members of most Atlantic-Caribbean, Indo-Pacific, and Mediterranean coastal and mesophotic communities; however, information about their susceptibility to diseases, predation, and competition, and their relationship with changing environmental conditions is limited. At least 17 diseases have been observed in at least 42 common octocoral species throughout their range. Twelve of these have been reported in the wider-Caribbean (CA), one in Brazil (BR), two in the Mediterranean (ME), one in the Eastern Pacific (EP), and three in the western Pacific (WP). Pathogenic and/or environmental causes have been identified for eight diseases, including terrestrial fungi, protozoan, bacteria and high temperature.. At least eight disease outbreaks have led to extensive octocoral mortalities in the CA, ME, BR, and EP with detrimental ecological consequences. The fungal disease Aspergillosis has produced the highest mortalities in the CA and the EP. Bacterial and fungal agents seemed to be responsible for the mass mortalities in the ME, BR and WP. Most outbreaks in all regions were linked to high thermal anomalies associated with climate change, which seems to be the major driver. Other biological stressors such as predation and/or competition produce injuries that may contribute to spread of infections and mortality. New diseases are being described almost every year concomitant with increasing seawater temperatures. The ecological and economic consequences could be devastating, with drastic changes in the seascape of shallow coral reefs and other coastal marine habitats and reduction of their ecological services. Given our limited knowledge, our best options for recovery of octocorals and coral reefs in general include sound management of coastal fisheries, control tourism, reduction of land- and sea-based pollution, and abating effects of climate change.

Keywords: Diseases, octocorals, World-wide epizootics, mass mortalities, Thermal anomalies, Climate change

REGIONAL-SCALE ELEVATION CHANGES IN MODERN CORAL REEF ECOSYSTEMS

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Healthy coral reefs serve as natural barriers that protect adjacent shorelines from coastal hazards, such as wave impacts from storms. Recent predictions, however, assert that anthropogenic impacts and climate change will cause the global degradation of coral reefs, leading to a net-erosional state by mid-century. To date, no studies have measured regional-scale elevation changes of coral reef ecosystems. We developed analysis techniques that used both contemporary bathymetric LiDAR and historical sounding data to estimate spatial variability in the amount of accretion and erosion for 5 coral reef ecosystems in the Atlantic, Pacific and Caribbean over the last several decades. Regional-scale mean-elevation and volume losses were observed at all 5 study sites, and in 77% of the 60 individual habitats that we examined across all study sites. Mean seafloor elevation losses for whole coral reef ecosystems in our study ranged from -0.09 m to -0.8 m, corresponding to net volume losses ranging from 3.4 to 80.5 million-cubic-meters for all study sites. Erosion of both coral-dominated substrate and non-coral substrate suggests that the current rate of carbonate production is no longer sufficient to support net accretion of coral reefs or adjacent habitats. This transition to a net-erosional state is effectively accelerating the rate of relative sea-level rise in these regions. Our results set a new baseline for projecting future impacts to coastal communities resulting from degradation of coral reef systems and associated losses of natural and socio-economic resources.

Los arrecifes de coral saludables actúan como barrera natural protegiendo las orillas adyacentes de peligros costeros tales como el impacto de las olas producidas por tormentas. Sin embargo, predicciones recientes afirman que impactos antropogénicos y cambios climáticos causaran la degradación global de arrecifes de coral, provocando una erosión neta para mediados del siglo. Hasta la fecha no ha habido estudios que midan cambios de elevación en ecosistemas de arrecifes de coral a escala regional. Nosotros desarrollamos técnicas de análisis que utilizaron LiDAR batimétrico contemporáneo y datos históricos de sondeo para estimar la variación espacial de la cantidad de acreción y erosión de las últimas décadas en 5 ecosistemas de arrecifes de coral en el Atlántico, el Pacífico y el Caribe. Se observaron pérdidas de volumen y de elevación promedio a escala regional en los 5 lugares y un 77% de los 60 hábitat individuales estudiados. La pérdida promedio del fondo marino en todos los ecosistemas de arrecife de coral en nuestro estudio oscilaron entre -0.09 m y -0.08 m, esto corresponde a una pérdida de volumen neta entre 3.4 a 80.5 millones de metros cúbicos. La erosión del substrato dominado por corales y la de no-corales sugiere que la tasa actual de producción de carbonato ya no es suficiente para sostener la acreción neta de arrecifes de coral o hábitat adyacentes. Esta transición a un estado de erosión neta está acelerando la tasa relativa del aumento del nivel del mar en estas regiones. Nuestros resultados establecen una nueva base de referencia para proyectar futuros impactos a las comunidades costeras afectadas

por la degradación de sistemas de arrecife de coral y por consiguiente de la pérdida de recursos naturales y socioeconómicos.

Keywords: seafloor erosion, lidar, elevation-change modeling

PHYSIOLOGICAL AND IMMUNOLOGICAL RESPONSE OF CORAL *ACROPORA CERVICORNIS* TO ALGAE OVERGROWTH

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Coral health can be compromised by biological (pathogenic), physical (bleaching, hurricanes) and anthropogenic (pollution) factors that could result in increased stress affecting metabolic functions. Currently, algae overgrowth due to overfishing of herbivores and increased nutrients is a major cause of coral tissue mortality. However, studies directly assessing the immunological and physiological response of corals to algae overgrowth are scarce. The goals for this study were to assess the immunological (enzymatic activity of antioxidants) and physiological (*Symbiodinium spp.* density and protein and Chl *a* concentrations) responses in the threatened staghorn coral *Acropora cervicornis* to algae overgrowth[EWM1]. To do this, six colonies with and six colonies without obvious filamentous algae overgrowth were randomly chosen in Tamarindo Bay, Culebra, Puerto Rico, to compare immune and physiological levels of apparent healthy tissue not in direct contact with filamentous algae and tissue in direct contact with the algae. The aim of this project is to evaluate whether the presence of algae results in oxidative stress throughout the whole colony or just locally in the area that is being overgrown. All pairwise comparison procedures showed that tissue under direct impact of algae overgrowth had significant lower levels of physiological parameters (protein concentration, symbiont density and chlorophyll *a* concentration) and higher levels of immunological activity (superoxide dismutase, catalase and peroxidase) than tissues not in contact with algae regardless of the colony being overgrown or not by it. Results suggest that filamentous algae overgrowth likely affects only coral tissue in direct contact and not necessarily the rest of the colony. Thus, given that immune response is likely localized, for management purposes it is recommended to remove tissue portion in contact with algae to prevent further tissue loss and allow coral to keep growing healthy.

Key words: innate immunity, oxidative stress, *Acropora cervicornis*, antioxidants

CORAL RESTORATION IN THE MEXICAN CARIBBEAN

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Coral reefs are highly diverse and productive ecosystems; however, over the last 40 years, coral populations have suffered significant decreases, mainly due to anthropogenic activities, natural catastrophes, and coral diseases. This situation has led to an increase in coral restoration efforts worldwide to offset the losses; either by using artificial reefs or focusing on particular species. Most coral restoration projects aim to increase coral biomass through the use of cloned corals fragments, often without consideration of the genetics of the donor colonies. By contrast, the use of sexual recruits has not often been applied in restoration programs but should be considered as an important component to maintaining or increases genetic diversity. Genetic diversity of coral populations is considered an important issue particularly in the face of global climate change and the potential for an increase in bleaching events and disease outbreaks, which could bias against clonal populations of corals. In the Mexican Caribbean, coral restoration programs have focused mainly on Acropora palmata and A. cervicornis, using cloned corals fragments and to a lesser extent the use of sexual recruits. However, there is no registry of the number and location of coral reef sites or areas covered by the different types of restoration projects. Therefore, in the present work, a review of the restoration programs throughout the Mexican Caribbean was carried out by gathering data on the number, location and type of techniques used. The analysis of the information generated has important considerations for the management of reef areas, as well as studies of genetic diversity.

Los arrecifes de coral son ecosistemas altamente diversos y productivos, sin embargo, en los últimos 40 años, la población coralina ha sufrido un decremento significativo, mayormente debido a actividades antropogénicas, catástrofes naturales y enfermedades coralinas. Esta situación ha provocado un incremento en los esfuerzos de restauración coralina a nivel mundial para compensar las pérdidas; utilizando arrecifes artificiales o enfocándose en especies particulares. La mayoría de los proyectos sobre restauración coralina tienen como fin incrementar la biomasa coralina empleando fragmentos de corales clones, a menudo sin considerar la genética de las colonias donadoras. En contraste, el uso de reclutas sexuales ha sido escasamente aplicado en los programas de restauración, pero debería ser considerado como un componente importante para mantener o incrementar la diversidad genética. La diversidad genética de las poblaciones coralinas se considera una cuestión important
e, en particular ante el cambio climático mundial y el posible aumento en los eventos de blanqueamiento y brotes de enfermedades, que podrían sesgar las poblaciones de corales clones. En el Caribe Mexicano, los programas de

restauración coralina se han enfocado principalmente en Acropora palmata y A. cervicornis, utilizando fragmentos de corales clones y en su minoría el uso de reclutas sexuales. Sin embargo, no existe un registro del número y ubicación de los sitios de arrecifes de coral o áreas cubiertas por los diferentes tipos de proyectos de restauración. Por lo tanto, en el presente trabajo, se realizó una revisión de los programas de restauración a lo largo del Caribe Mexicano, recopilando datos sobre el número, ubicación y tipo de técnicas utilizadas. El análisis de la información generada posee consideraciones importantes para el manejo de las áreas arrecifales, así como estudios de diversidad genética.

Keywords: sexual recruits, fragmentation, genetic diversity, Acropora

RESTORATION OF SEAGRASS IN THE REEF LAGOON OF PUERTO MORELOS, QUINTANA ROO

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Seagrasses play an important role in shallow tropical ecosystems and adjacent coastal areas. Actually, they are declining due to diverse anthropogenic and natural impacts. The natural recovery of seagrasses can take decades and is highly variable and unpredictable. Therefore, artificial restoration could be a useful tool to recover lost seagrass beds. For artificial restoration, it is important to understand the natural cycles of the system. The recolonization of beds in the Caribbean, usually begins with the pioneer seagrass specie *Halodule wrightii*, which facilitates the establishment of the more robust and climax specie *Thalassia testudinum*. This research is a pilot project focusing on the restoration of a bare sandy area that lost its seagrasses due to Hurricane Wilma (Oct 2005) in the reef lagoon of Puerto Morelos. In the experimental design, core transplants (diameter 4.5 cm) of *H. wrightii* were placed in 24 plots of 2 x 2 m at densities of 9 or 25 cores per plot; with or without fertilizer. Control plots did not receive transplants or fertilizer. The survival and expansion of the *H. wrightii* will be determined. After 6 months, seeds of *T. testudinum* will be placed in the experimental plots and we hypothesize that the seeds have more chance of survival in plots with high densities of *H. wrightii*. The preliminary results of this design will be presented.

Los pastos marinos cumplen un papel importante en ecosistemas tropicales poco profundos y las zonas costeras adyacentes. Actualmente, están disminuyendo debido a diversos impactos antropogénicos y naturales. La recuperación natural de los pastos marinos puede tardar décadas y es muy variable e impredecible. Por lo tanto, la restauración artificial pode ser una herramienta útil para recuperar los lechos de pastos marinos perdidos. Para la restauración artificial, es importante entender los ciclos naturales del sistema. La recolonización de los lechos en el Caribe, por lo general comienza con la especie pionera de pasto marino *Halodule wrightii*, que facilita el establecimiento de la especie más robusta y climax *Thalassia testudinum*. Este trabajo es un proyecto piloto que se centra en la restauración de una zona arenosa desnuda que perdió sus pastos marinos debido al huracán Wilma (octubre de 2005) en la laguna de arrecifes de Puerto Morelos. En el diseño experimental, los trasplantes de núcleo (diámetro 4,5 cm) de *H. wrightii* se colocaron en 24 parcelas de 2 x 2 m a densidades de 9 o 25 núcleos por parcela; con o sin fertilizante. Las parcelas de control no recibieron trasplantes ni fertilizantes. Se determinará la supervivencia y expansión del *H. wrightii*. Después de 6 meses, las semillas de *T. testudinum* serán colocadas en las parcelas experimentales y se plantea la hipótesis de que las semillas tienen más posibilidades de supervivencia en parcelas con altas densidades de *H. wrightii*. Los resultados preliminares de este diseño serán presentados.

Keywords: RETORATION, SEAGRASS, RECOLONIZATION, MEADOW, EXPERIMENTAL PLOTS, TRANSPLANTING CORES.

DEMOGRAPHIC DYNAMICS OF FUSED STAGHORN CORAL (*ACROPORA PROLIFERA*) IN A SHALLOW, HIGH-WAVE ENERGY URBAN CORAL REEF.

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Fused staghorn coral, *Acropora prolifera*, is a hybrid species between threatened elkhorn coral, *A. palmata*, and staghorn coral, *A. cervicornis*, both of which have undergone drastic population declines mostly due to disease, bleaching and anthropogenic disturbances since the early 1980's. These reef-building corals produce a tridimensional structure that provides habitat and shelter for multiple species against predators and wave action. *A. prolifera*, which is morphologically similar to *A. cervicornis*, plays the same role. Many studies on population dynamics and recovery have been done for *A. palmata* and *A. cervicornis*, but there is a lack of information regarding the ecology and demography of *A. prolifera*. *A. prolifera* is known to proliferate in small localized areas across different shallow, high-energy, urban coral reef systems. The goal of this project was to compare the survivorship and growth rates between loose and fixed fragments of *A. prolifera* in a coral reef at El Escambrón, in San Juan, Puerto Rico where the hybrid is relatively abundant. Preliminary results indicate that survival rates between loose fragments vs. fixed fragmentsdiffers significantly, with significantly lower survivorship for loose colonies (x^2=12.012, df=1, p<0.05). Survival of loose fragments was size-dependent (x^2=7.583, df=2, p<0.05) with small colonies suffering higher mortality. On the contrary, survival of fixed fragments did not vary with size (x^2=1.351, df=2, p>0.05). A decrease is size was observed in both loose and fixed, but the loose fragments are losing tissues approximately 4 times faster than the fixed fragments. This study provides essential demographic information to better understand whether *A. prolifera* can have the same ecological impacts as *A. cervicornis* and *A. palmata*.

El coral fundido, *Acropora prolifera*, es una especie híbrida entre el coral de cuerno de alce, *A. palmata* y el coral de cuerno de ciervo amenazado *A. cervicornis*, que han sufrido un descenso poblacional drástico debido principalmente a enfermedades, blanqueamiento y disturbios antropogénicos desde principios de 1980. Estos corales creadores de arrecifes producen una estructura tridimensional que proporciona hábitat y refugio para múltiples especies contra depredadores y la acción de las olas. También se cree que *A. prolifera*, que es morfológicamente similar a su congénere, puede desempeñar el mismo papel. Se han llevado a cabo muchos estudios sobre la dinámica de la población y la recuperación de *A. palmata* y *A. cervicornis*, pero hay una falta de información sobre la ecología y la demografía de *A. prolifera*. *A. prolifera* se sabe que prolifera en pequeñas áreas localizadas a través de diferentes superficies de alta energía en sistemas de arrecifes de coral urbanos. El objetivo de este proyecto fue comparar las tasas de supervivencia y crecimiento entre fragmentos sueltos y fijos de *A. prolifera* en un arrecife de coral en El Escambrón, en San Juan, Puerto Rico, donde la "especie" es relativamente abundante. Los resultados preliminares indican que las tasas de supervivencia entre fragmentos sueltos vs. fragmentos fijos difieren significativamente, siendo menores para las colonias sueltas (x2 = 12.012, df = 1, p <0.05). La supervivencia en los fragmentos sueltos fue dependiente del tamaño (x2 = 7.583, df = 2, p <0.05) con colonias pequeñas sufriendo una mayor mortalidad. Por el contrario, la supervivencia de los fragmentos fijos no varió con el tamaño (x2 = 1.351, df = 2, p>

0,05). Se observó una disminución en el tamaño tanto en los sueltos como en los fijos, pero los fragmentos sueltos pierden tejido aproximadamente 4 veces más rápido que los fragmentos fijos. Este estudio proporciona información demográfica esencial para comprender mejor si *A. prolifera* puede tener los mismos impactos ecológicos que *A. cervicornis* y *A. palmata*.

Key words: *Acropora prolifer*a, colony survival, demographic dynamics, high-energy coral reef, skeletal growth, urban coral reef

EXPRESSION OF THE RECEPTOR FOR ACTIVATED C KINASE 1 AT DIFFERENT DEVELOPMENTAL STAGES OF THE JELLYFISH *CASSIOPEA XAMACHANA*

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The life cycle of jellyfish comprises sexual and asexual reproduction. The non-fertilized female eggs are generally located inside the central body. The male releases the sperm gametes into the water column where they enter the female body and fertilize the eggs. Fertilized eggs further develop into larvae that swim freely in the water. Then, upon detection of some chemical cues, the larvae settle on the substrate bottom where it metamorphoses and develops as a polyp or scyphistoma. Then, after they are infected by *Symbiodinium*, further metamorphosis, along with a process called strobilation, occurs. During this process, the polyp tentacles are contracted and the calyx undergoes pulsating movements that eventually release the young jellyfish called ephyra, which will become adult jellyfish. On the other hand, the asexual cycle involves the polyp stage, from which a bud forms, which it is then released as a planula (asexual larvae). RACK1 is a 36 kDa scaffold protein with seven WD-40 domains, member of the WD-repeat family of proteins. RACK1 is involved in important cellular processes such as differentiation, signal transduction, cell-cell contact, transcription, and protein synthesis, among others. The main aim of this work is to study the relative expression of RACK1 during the developmental stages of *Cassiopea xamachana*, to determine the possible involvement of RACK1 in such developmental process. By qPCR, we observed that the RACK1 transcript displayed a basal level of expression at most stages (larva, polyp, strobile, and tentacle and umbrella in adult jellyfish). However, at the ephyra stage, upregulated expression was observed. This observation is consistent with a putative role of RACK1 in signalling that would orchestrate various downstream responses that trigger movement, adhesion, chemotactic cell migration, and contraction, possibly through binding to different partners as it has been reported for dynein, actin, talin, and/or integrins.

El ciclo de vida de las medusas comprende tanto reproducción sexual como asexual. Los huevos no fertilizados se encuentran en la parte central de la hembra. El macho libera el esperma en la columna de agua donde los huevos después de fertilizados, se desarrollan en larvas ciliadas de vida libre. Tras la detección de algunas señales químicas, las larvas se asientan en un sustrato donde sufren metamorfosis y se desarrollan a pólipo. Después de que estos son infectados por *Symbiodinium*, una metamorfosis adicional ocurre en un proceso llamado estrobilación, donde los tentáculos del pólipo comienzan a contraerse y el cáliz sufre movimientos pulsantes que liberan medusas juveniles llamadas éfiras que se convertirán en medusas adultas. Por otro lado, el ciclo asexual involucra la formación de yemas debajo el cáliz del pólipo, que se liberan como plánulas (larvas asexuales) y se convierten en pólipos nuevamente. RACK1 es una proteína de andamiaje de 36 kDa con siete dominios WD-40, miembro de la familia de proteínas con repeticiones WD. RACK1 participa en importantes procesos celulares como diferenciación, transducción de señales,

contacto célula-célula, transcripción, y síntesis de proteínas, entre otros. El objetivo principal de este trabajo es estudiar la expresión relativa de RACK1 durante las etapas del desarrollo en *Cassiopea xamachana*, para determinar su posible implicación durante dicho desarrollo. Mediante qPCR, observamos que la transcripción de RACK1 mostró un nivel basal de expresión en casi todas las etapas (larva, pólipo, estrobilos, y tentáculos y campana en medusas adultas). Sin embargo, en la etapa de éfira, se observó una sobre-expresión. Esta observación es consistente con un hipotético papel de RACK1 en señalización, que orquestaría respuestas corriente abajo para desencadenar movimiento, adhesión, migración, y contracción celular, posiblemente a través de la unión con diferentes ligandos, como se ha reportado para dineína, actina, talina, y/o integrinas.

Keywords: *Cassiopea xamachana*, development, RACK1, signaling, *Symbiodinium*, symbiosis

USING PHOTOGRAMMETRY AND THREE DIMENSIONAL (3D) MODELLING FOR MONITORING CORAL REEF HABITATS

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The three-dimensional framework of coral reefs underpins the community structure, species diversity, and overall functionality of these complex ecosystems. Reef managers monitor coral reef communities in order to track long-term changes in coral and fish assemblages, to document local and large-scale disturbances, and to acquire the necessary data to inform adaptive reef management strategies. Conventional coral reef monitoring methods (e.g., chain link, point intercept and planar photography) yield medium resolution data where the spatial information is either partial or absent. However, recent technological advances in the fields of digital imaging, photogrammetry software, and desktop computing and storage capabilities make it possible to expand the scope of sampling data in quantity and quality by allowing larger areas to be surveyed and by capturing three dimensional data for these areas. These tools increase the efficiency of reef surveys by generating enhanced spatial data sets and allowing for extraction and analysis of more comprehensive reefscape metrics.Here we describe the use of photogrammetry for mapping and modelling Jamaica's CARICOMP site which has been monitored by conventional survey methods since 1993.

El marco tridimensional de los arrecifes coralinos sustenta la estructura comunitaria, la diversidad de las especies y la funcionalidad general de estos complejos ecosistemas. Los gestores de los arrecifes monitorean los sistemas arrecifales a fin de rastrear los cambios a largo plazo en las comunidades de corales y peces, documentar los disturbios locales y en gran escala, y adquirir los datos necesarios para informar las estrategias adaptativas de manejo de los arrecifes. Los métodos convencionales de monitoreo de arrecifes de coral (por ejemplo, enlace de cadena, interceptación de puntos y fotografía plana) producen datos de resolución media donde la información espacial es parcial o ausente. Sin embargo, recientes avances tecnológicos en los campos de imagen digital, de software fotogramétrico, y de las capacidades de computación y almacenamiento de datos amplían el alcance, la cantidad y la calidad de los datos, permitiendo que se encuesten áreas más grandes y captand
o datos tridimensionales para estas áreas. Estas herramientas aumentan la eficiencia de las encuestas de arrecife generando conjuntos de datos espaciales mejorados y permitiendo la extracción y el análisis de métricas más completas de sistemas arrecifales.

Aquí describimos el uso de la fotogrametría para cartografiar y modelar el sitio de CARICOMP de Jamaica que ha sido monitoreado por métodos de encuestas convencionales desde el año 1993.

Keywords: Coral reefs, Photogrammetry, 3D reef structure,

HORMONAS ESTEROIDES Y SU RELACIóN CON LOS EVENTOS REPRODUCTIVOS EN EL GASTERóPODO *STROMBUS PUGILIS*

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Reproduction in molluscs, as in other organisms, is determined by steroid hormones. Knowing their functions in the reproductive process is fundamental to develop their aquaculture without relying on seasonality, the collect of egg masses of the natural environment and its population stock. The present investigation was carried out with the purpose of quantifying the levels of testosterone, estradiol and progesterone in the fighting conch (*Strombus pugilis)*, as well as their temporal variation during their reproductive cycle. Thirty individuals each of *S. pugilis* (adults) were collected during September, November and February corresponding to the months of maturity, spawning, and rest stage (n = 90, 2015-2016). Biometrics of each organism was recorded and the gonad-digestive gland complex was dissected. Extraction of steroids was done using methanol 80% for their analysis by enzyme-immunoassays. The three hormones presented higher concentrations in September and November, coinciding with the periods of reproductive activity. Weight of the gonad was positively correlated with the hormonal concentration of the organisms. The knowledge generated in this study expands the basic knowledge of reproduction of this specie and could be used for the development of technologies that allow controlled reproduction in the laboratory and conch aquaculture.

La reproducción en moluscos, se considera que al igual que en otros organismos, está determinada por las hormonas esteroides. Conocer sus funciones en el proceso reproductivo es fundamental para desarrollar su acuicultura sin depender de la temporalidad, la semilla del medio natural y su stock poblacional. La presente investigación se realizó con la finalidad de cuantificar los niveles de testosterona, estradiol y progesterona en el caracol luchador (*Strombus pugilis)*, así como su variación temporal durante el ciclo reproductivo. Se realizaron colectas de *S. pugilis* (adultos) durante septiembre, noviembre y febrero, meses correspondientes a la madurez, desove y reposo de su ciclo reproductivo (n= 90, 2015-2106).Se registró la biometría de cada organismo y se obtuvo el complejo gónada-glándula digestiva. Posteriormente se realizó la extracción de esteroides con metanol al 80% para su análisis mediante enzimo-inmunoensayos. Las tres hormonas presentaron mayores concentraciones en septiembre y noviembre, coincidiendo con las épocas de actividad reproductiva. Se llevó a cabo el análisis del peso de la gónada respecto a la concentración hormonal de los organismos. El conocimiento generado en este estudio expande el conocimiento de los eventos reproductivos de esta especie con la finalidad de desarrollar tecnologías que permitan la reproducción controlada en laboratorio y acuicultura.

Keywords: *Strombus*, reproduction, steroids

CALCAREOUS GREEN ALGAE CARBON CONTRIBUTION IN A TROPICAL SEDIMENTARY COAST OF YUCATAN, MEXICO

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Yucatan has 378 kilometers of coastline with large seagrass and Calcareous green algae (CGA) meadows that provide important services to the region. CGA are important producers of carbonaceous sediments in coastal environments, however, little is known of their actual mass and seasonal dynamics. In this study, the CGA standing stock (as dry weight) and its Organic Matter (OM) and Inorganic carbon (CaCO3) contribution (loss on ignition 500 °C) were estimated along the north coast of Yucatan at two sampling sites (Cerritos 1 and Cerritos 2), five times between summer 2014 and summer 2015. Three CGA species: *Halimeda incrassata*, *H. opuntia* and *Penicillus dumetosus* contributed a standing stock annual average of 1214.8 g m2 of which 89% corresponded to CaCO3 and 11% to OM. From the three species present, the largest standing stock was from *H. opuntia* (annual average 1142.9 g m2). Seasonal changes were significant correlated with changes in temperature (Kendall Tau_b correlation 0.161** $p < 0.0001$); Significant seasonal differences were found ($p < 0.05$) with a maximum of 1335.5 g m2, CaCO3 1178.1 g m2, OM 156.4 g m2 in summer time in Cerritos 2. The CGA annual average mass reported in this study are above the values reported for the Caribbean side of the peninsula, where *H. incrassata* a have been reported as the dominant species; while in our study sites *H. opuntia* is dominant and its high biomass is consistent with the "weedy" behavior reported in reef sites, making this species an important contributor of OM and CaCO3 into the local system. Temporal differences might result from seasonal variation in temperature and irradiance. This study provides the base line for future estimation of carbon production of CGA for the Yucatan.

Keywords: Green calcareous algae; Standing stock; Organic and inorganic carbon; Calcium carbonate, Yucatan Peninsula

DOES UNOCCUPIED MICROHABITAT PATCH SIZE AFFECT EARLY POST-SETTLEMENT DEMOGRAPHICS IN A CARIBBEAN REEF FISH?

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Expected increases in frequency and intensity of physical disturbances under climate change will result in increases in microhabitat fragmentation and episodic high mortality of resident fish populations, freeing previously occupied space. It is important to understand how such increases can affect reef fish population replenishment, particularly during the early post-settlement stage of reef fishes, when they are most vulnerable to competition and predation. This study looks at the effect of microhabitat patch size on the abundance, survivorship and growth of newly settled bicolour damselfish *Stegastes partitus* in the absence of older resident fishes. We used standardized microhabitat settlement units (area: 0.28m2) arranged in two different patch size configurations, i.e. small (1 unit) and large (2x3 units), to monitor the abundance of bicolour recruits onto replicate size patches during, and several weeks after, a large natural settlement pulse. We expected that smaller patches would exhibit lower recruit abundance but higher density than larger patches because of their lower perimeter-to-area ratio. Consequently, we also expected stronger intra-cohort density-dependent effects on recruit growth and early-post settlement mortality in the small patches. Over a three-week period, we recorded a total 225 bicolour recruits onto the experimental patches. As predicted, we found that the smaller patches had lower abundances (averages: 8.8 versus 36 recruits/patch) but higher densities (31.4 versus 21.4 recruits/m2) than larger patches. This resulted in higher aggression rates among recruits in the smaller patches. However, we found no difference in recruit growth or mortality rates between patch treatments, indicating no measurable effects of aggression on these demographic rates. Since the natural recruit densities here observed are among the highest reported for bicolours, our results indicate that this species readily tolerates unusually high crowding soon after settlement and therefore its post-disturbance population replenishment might be less affected by habitat fragmentation than in other species.

Keywords: Bicolour damselfish, habitat fragmentation, density-dependence

SPOT BLEACHING IN ELLIPTICAL STAR CORAL (*DICHOCOENIA STOKESII*) IN ST. KITTS

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Dichocoenia stokesii occurs in shallow, coastal Caribbean reefs of St. Kitts, and often shows a bleaching pattern ('spot bleaching'). The aim of this study is to describe the spot bleaching and its progression over time. Twenty-six *D. stokesii* colonies were tagged at two to five meter depths in 3 reefs between August and September 2016, and were photo-documented at two to three week intervals for 7 months. Spot bleaching in *D. stokesii* consisted of multifocal to coalescing, discrete, circular to oblong 1-3 cm areas, where the coral tissue is intact, but pale yellow-tan to white (paled to bleached), rather than the brown-tan color typical for the species. Corallites within affected areas were often slightly raised or pulvinate, and were occasionally more widely spaced apart. In some instances, bleached areas had central foci of tissue loss. Spot bleaching lesions showed little change over the study period, and did not appear to readily progress to areas of partial colony mortality, but for some, the degree of bleaching fluctuated, and small foci of tissue loss developed. Preliminary histopathological analysis showed calicodermal reaction associated with large numbers of endolithic fungi. There were also ciliates associated with the epidermal surface, focal zooxanthellae reduction especially in the surface body wall, and foci of surface body wall atrophy with degeneration and loss. Further investigation is underway to clarify whether the ciliates and endolithic fungi are localized to the bleached areas and are absent in non-lesioned corals. Environmental stress (e.g. solar or thermal exposure) seems an unlikely immediate cause because the lesions changed so little over the study period.

Keywords: pathology, Dichocoenia, bleaching, histology, disease

THE PHYSIOLOGICAL RESPONSE OF PELAGIC *SARGASSUM* TO INCREASED NUTRIENTS AND *SARGASSUM* DECOMPOSITION UNDER STRESSFUL CONDITIONS

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Sargassum, a pelagic seaweed commonly found in the Sargasso Sea, has recently arrived in unusually large quantities to the Caribbean and Gulf of Mexico, causing numerous problems for coastal ecosystems and economies. In order to better understand the capacity of this seaweed to alter coastal ecosystems, we performed 9-day growth experiments in outdoor mesocosms to determine the physiological responses of two species (*S. natans, S. fluitans*), commonly found in the Caribbean, to different nutrient levels. We exposed *Sargassum* to three treatment groups: a moderate nutrient level, a high nutrient level, and decomposing *Sargassum*. The nutrient treatments were meant to simulate moderate and high coastal eutrophication, while decomposing *Sargassum* was expected to create a positive feedback loop, further enhancing *Sargassum* growth rates. Temperature was not controlled within the mesocosms and therefore was usually higher than ocean temperatures creating a stressful environment for the specimens. Under these stressful conditions, we found that in most cases the *Sargassum* actually lost biomass. However, we found that *S. natans* either grew more or lost significantly less biomass than *S. fluitans* under these stressful conditions. Additionally, *S. natans* presented higher maximum quantum yield (Fm/Fm) at the end of the experiment in all treatments, indicating less photosynthetic stress. While the specimens exposed to the two increased nutrient levels fared significantly worse than the control, we found that the *Sargassum* in the decomposition treatment grew more than the control. This suggests that we could see a positive feedback loop in areas where *Sargassum* has inundated the shores causing further alteration of the coasts.

Keywords: *Sargassum*, growth, physiology, photosynthesis, mesocosms

MASSIVE *SARGASSUM* LANDINGS: ALTERATIONS IN *ACROPORA PALMATA* NATURAL SETTLEMENT

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Sargassum landings are a natural phenomenon in the Caribbean coasts; however, during recent years, atypical massive events have been observed, affecting oxygen, pH, nutrients levels, as well as reducing the transparency of the water column. As it is an unusual phenomenon, there is little information available on the effects of the massive *Sargassum* drifts and landings on coral reef organisms. This work describes the effect of Sargassum on settlement of *Acropora palmata* larvae. During August 2015 larvae were obtained from *A. palmata* spawning, the larvae were incubated in either filtered sea water, reef water and or lagoon water containing *Sargassum*, as well as all of the above-mentioned categories in which a *Sargassum* frond was added. During eight days, counts were recorded on the number of settled larvae, swimming larvae and larvae associated with the *Sargassum* blades. In general, poor larval settlement was observed in reef lagoon water incubations (18%) and a higher number of swimming larvae (78%), in comparison with the filtered sea water treatment (90% settled larvae and 4% swimming), while values for reef water treatment fluctuated between these two categories. Furthermore, a high incidence of larvae associated or was trapped amongst the *Sargassum* blades, and a smaller number of larvae settled in the incubations with *Sargassum* fronds. The results highlight the importance of the massive *Sargassum* landings in the settlement and survival of coral larvae, as well as in the possible modifications of the natural larval distribution patterns.

Las afluencias de sargazo son un fenómeno natural que experimentan las costas del Caribe, no obstante, durante últimos años, se han observado eventos atípicos de afluencias masivas, lo que afecta los niveles naturales de oxígeno, pH, nutrientes, además de reducir la transparencia de la columna de agua. Al ser un fenómeno inusual, existe poca información sobre el efecto de las afluencias masivas de sargazo sobre los organismos arrecifales, en este sentido, en el presente trabajo se observó el efecto del sargazo en el asentamiento y sobrevivencia de larvas de *Acropora palamata*. Durante agosto del 2015, se obtuvieron larvas del desove de *A. palmata*, estas se incubaron por triplicado en agua de mar filtrada, agua del arrecife y agua de la laguna arrecifal (con residuos de sargazo), así como todas las categorías antes mencionadas a las cuales se les

adiciono una fronda de sargazo. Durante ocho días, se realizaron conteos del número de larvas asentadas, larvas nadando de forma libre y larvas asociadas con las láminas de sargazo. En general, se observó, un menor asentamiento de larvas en las incubaciones con gua de la laguna arrecifal (18 %) y un mayor número de larvas nadando (78%), contrario a lo que sucede en el agua de mar filtrada (90% de larvas asentadas y 4% nadando), mientras que los valores para el agua del arrecife fluctuaron entre estas dos categorías. Así mismo, se observó, una alta incidencia de larvas asociadas o atrapadas a las hojas de sargazo, y un menor número de larvas asentadas en las incubaciones con ramas de sargazo. Los resultados obtenidos, ponen de manifiesto, la importancia de las afluencias de sargazo en el asentamiento y supervivencia de larvas de coral, así como en la posible modificación de los patrones naturales de distribución de las mismas.

Keywords: *Sargassum*, coral settlement, larval distribution patterns

SEA URCHIN RELOCATION INCREASES OVERALL SUCCESS OF URBAN CORAL REEF COMPENSATORY MITIGATION AND REHABILITATION

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Urban development along tropical shorelines often have significant adverse environmental consequences on adjacent shallow coral reef systems. Therefore, compensatory mitigations may often involve relocation of potentially impacted coral colonies. In a recent large coastal development project in northwestern Puerto Rico a total of 1,780 colonies of ten Scleractinian species were removed from the project's footprint and adjacent bottom, and relocated along six different plots across the outer segments of two fringing, high-energy, urban reefs in 2013 and 2015. Also, a total of nearly 17,000 sea urchins of six species were relocated to the same areas. Continuous monitoring of the numerically dominant out-planted corals, *Pseudodiploria strigosa* and *Porites astreoides* showed survival rates in one of the reefs ranging from 97 to 100%, and from 99 to 100% in the other. Colony growth rates of out-planted corals of both species was significantly higher than in control wild colonies. Partial colony mortality was sporadic and resulted mostly from partial sediment bedload impacts across two of the six plots, a temporary effect associated to the alteration of local sediment dynamics due to the construction of a riprap. Turbidity pulses associated to construction caused temporary partial colony mortality in *P. astreoides* across three of the plots, and in wild colonies. But tissue was rapidly regenerated. Sea urchins showed very low density (<0.1 individual/m2) or were completely absent before out-planting. Densities increased to 1-5 individuals/m2 after out-planting 2-4 years ago, and have remained between 0.25 and 1 individual/m2 since then. Localized increased herbivory within coral out-planting areas has strongly removed macroalgae and turf, resulting in increased crustose coralline algae and open substrate cover. Thriving out-planted corals benefit from the elimination of out-competing macroalgae by sea urchin herbivory. Sea urchin translocation is a fundamental tool to enhance coral reef recovery and sustain coral populations, and resilience.

Los desarrollos a lo largo de las costas tropicales generalmente tienen efectos adversos en los arrecifes de coral adyacentes. Por lo tanto, las mitigaciones compensatorias a menudo pueden implicar la reubicación de las colonias de coral. En un proyecto reciente de desarrollo en el noroeste de Puerto Rico, un total de 1,780 colonias de diez especies de corales Escleractinios se removieron de la huella del proyecto y se relocalizaron a lo largo de seis parcelas a través de los segmentos externos de dos arrecifes marginales. Además, un total de casi 17,000 erizos de mar de seis especies se reubicaron en las mismas áreas. El monitoreo continuo de los corales trasplantados *Pseudodiploria strigosa* y *Porites astreoides* mostraron tasas de supervivencia que van del 97 al 100% en

un arrecife, y del 99 al 100% en el otro. Las tasas de crecimiento de las colonias fueron significativamente mayores que en colonias control. La mortalidad parcial de las colonias fue temporera debido al impacto del desplazamiento horizontal de sedimentos en dos de las seis parcelas, un efecto temporero asociado a la alteración de la dinámica local de los sedimentos por la construcción de un “riprap”. Sin embargo, el tejido se regeneró rápidamente. Los erizos de mar mostraron una densidad muy baja (<0.1 individuos/m2) o estaban completamente ausentes antes de replantar. Las densidades aumentaron hasta 1-5 individuos/m2 después de haber sido plantados, y han permanecido entre 0.25 y 1 individuo/m2 desde entonces. El aumento en la herbívora dentro de las áreas de trasplante ha reducido fuertemente las macroalgas, dando como resultado un aumento en la cobertura de sustrato abierto. La relocalización del erizo de mar es una herramienta fundamental para mejorar la recuperación de los arrecifes de coral, y sostener las poblaciones de coral y la resiliencia de los mismos.

Keywords: Compensatory mitigation, Coral out-planting, Sea urchin relocation, Population dynamics, Restoration, Urban coral reef

VICARIANT PROCESSES IN *GRACILARIOPSIS E.Y. DAWSON* (RHODOPHYTA) IN THE YUCATAN PENINSULA

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Gracilariopsis is an important genus of the family Gracilariaceae that comprises 24 cylindrical species taxonomically accepted, worldwide distributed. These species represent an economically important resource due to the constitution of their cell wall which is composed by 70%, by agar. *Gracilariopsis lemaneiformis* is one of the 100 species of widely distributed red algae which stands out for having a disjointed distribution area, since it has been registered for the coasts of the American Tropical Pacific, the Gulf of Mexico and the Mexican Caribbean. To provide a biogeographic explanation for this type of distribution, a phylogenetic analysis was performed from rbcL sequences of Mexican specimens of *G. lemaneiformis* and genbank sequences. Our results revealed that the specimens that have been recorded in the Gulf of Mexico as *G. lemaneiformis*, correspond to *G. cataluziana*, specimens from the Mexican Caribbean and Caribbean Sea corresponded with *G. tenuifrons*, while those from the American Tropical and Subtropical Pacific corresponded with *G. costarricensis*. These results showed that *G. lemaneiformis* is restricted to the South American Pacific. In the resulting topology, we observed a clade integrated by *G. lemaneiformis* and *G. costaricensis*, which in turn was the sister group of G. carolinensis (distributed in the American Subtropical Atlantic), revealing the first great vicariant event: the closure of the Isthmus of Panama. In a second clade, two subclades were obtained: the first, corresponding to the Eastern Atlantic, integrated by *G. longissima*, *G. funiculata* and *G. megaspora*, and the second one, corresponding to the Gulf of Mexico and the Caribbean Sea, integrated by *G. cataluziana* and *G. tenuifrons*, respectively. The dichotomy in these two subclades was explained by the formation of the Antillean Arc, while the second subclade was in turn explained by the emergence of the Yucatan Peninsula.

Gracilariopsis es un importante género de la familia Gracilariaceae que comprende 24 especies cilíndricas taxonómicamente aceptadas, de amplia distribución mundial. Dichas especies representan un recurso económicamente importante debido a la constitución de su pared celular, la cual está conformada, en un 70%, por agar. *Gracilariopsis lemaneiformis*, es una de las 100 especies de algas rojas ampliamente distribuidas, que llama la atención por presentar un área de distribución disyunta, ya que ha sido registrada para las costas del Pacífico tropical americano, el Golfo de México y el Caribe mexicano. Con la intención de proporcionar una explicación biogeográfica a este tipo de distribución, se realizó un análisis filogenético a partir de secuencias de rbcL de especímenes mexicanos de *G. lemaneiformis* y secuencias del genbank. Los resultados revelaron que los especímenes que han sido registrados en el Golfo de México como G. lemaneiformis, corresponden con G. cataluziana; a su vez, los especímenes del Caribe mexicano y Mar Caribe, correspondieron con G. tenuifrons, mientras que aquellos del Pacífico tropical y subtropical americano correspondieron con G. costarricensis. Estos

resultados dejaron de manifiesto que *G. lemaneiformis* está restringida al Pacífico sudamericano. En la topología resultante, observamos un clado conformado por *G. lemaneiformis* y *G. costaricensis* que a su vez fue el grupo hermano de G. carolinensis (distribuida en el Atlántico subtropical americano), revelando el primer gran evento vicariante: el cierre del istmo de Panamá. En un segundo clado, se obtuvieron dos subclados: el primero, correspondiente al Atlántico del Este, compuesto por *G. longissima, G. funiculata* y *G. megaspora*, y el segundo, correspondiente al Golfo México y Mar Caribe, compuesto por *G. cataluziana* y *G. tenuifrons*, respetivamente. La dicotomía en estos dos subclados fue explicada con la formación de arco antillano, mientras que, el segundo subclado, fue a su vez explicado por la emersión de la Península de Yucatán.

Keywords: biogeography, Gracilariaceae, phylogeny, rbcL, red algae, vicariance

BLUE CARBON ECOSYSTEMS OF MEXICO

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Mexico has more than 750,000 ha of mangroves and more than 900,000 ha of seagrasses. However, approximately 200,000 ha of mangroves and an unknown extension of seagrass have also been lost. These are two of the three coastal ecosystems that are part of the Blue Carbon Initiative, so Mexico has a great opportunity for mitigation and adaptation to the impacts of climate change. With the objective to evaluate this potential, a documentary investigation of studies made in mangroves and seagrasses that could be useful to estimate the stocks, capture and carbon emissions by the mangroves ecosystems and seahgrasses of Mexico was carried out. The results indicate that Mexico has a high potential for mitigation and adaptation to climate change through the conservation and restoration of mangroves and seagrass ecosystems. Regrettably, it will increase contributions to global warming by emissions of greenhouse gases if the human development continue to deteriorate these ecosystems. The degradation of these ecosystems means that different environmental services related to the storage and capture of carbon such as biodiversity, storm protection, fisheries and recreation are lost.

Keywords: Blue Carbon, Mangroves, Seagrasses, Climate Change, impacts, conservation

DOES MORPHOLOGY OF *PENICILLUS* SPP. AFFECT ITS USAGE AS INVERTEBRATE HABITAT?

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Macroalgae has been well established as a contributor to habitat complexity in shallow coastal habitats, including seagrass beds. Previous studies have surveyed the role of algal mats and individual algal thallus (such as the caps of *Penicillus* spp.) in increased macro-invertebrate diversity. South Florida is unique in its array of anthropogenic influences (e.g. freshwater flow, pollution, etc.), restoration projects, and environmental gradients. How these factors can affect suitability of particular macroalgae as habitat for invertebrate groups is unclear. The purpose of this pilot study is to discern whether the morphology of *Penicillus* spp. affects the diversity of invertebrates that live on the algae in south Florida. Two sites were chosen along opposite ends of south Florida (Sprigger Bank in Florida Bay and Deering Estate in Biscayne Bay). Deering Estate is more prone to anthropogenic influence than Sprigger bank. Preliminary observations of *Penicillus capitatus* morphology between sites show differences in cap and thallus height. From data collected in March 2017, the average thallus height of *Penicillus capitatus* in Florida Bay is 12.19 cm, while average *P. capitatus* thallus height in Deering Estate is 2.11 cm. Average cap height between Sprigger Bank and Deering Estate are 3.57 cm and 1.62 cm, respectively. While research is ongoing, these difference can have implications in the surface area in which invertebrates can live on the *Penicillus* thalli.

Keywords: Macroalgae, Invertebrates, Florida, Species Diversity, Ecology, Habitat

RACK1 AND INTERACTING PROTEINS FROM *SYMBIODINIUM*

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Coral reefs are the most diverse and valuable ecosystems on Earth as they support more species per unit area than any other marine environment. A variety of cnidarians including corals establish endosymbiotic associations with dinoflagellates of the genus *Symbiodinium*. The interest on understanding the biological mechanisms that lead to the acquisition and loss of this symbiotic association has increased in the last decades due to the rise in frequency and severity of coral bleaching events that occur as a consequence of elevated sea temperatures. We have focused on the study of signal transduction molecules involved in pathways that may potentially regulate the life cycle and/or symbiotic interactions of *Symbiodinium* with their hosts, and used the jellyfish *Cassiopea xamachana* as a model to study such cnidarian-dinoflagellate relationship. We have indentified and characterized the *Symbiodinium* hub protein RACK1 (Receptor for Activated C Kinase 1), which is known to participate in several signaling pathways. We amplified, cloned and sequenced the RACK1 transcript and encoding genes from *Symbiodinium microadriaticum* (SmicRACK1). Analysis of the transcript by qRT-PCR revealed a differential accumulation at several stages of the growth of cultured *Symbiodinium* and its light/dark phases of the photoperiod. These data indicated that SmicRACK1 is functionally required at different points of development and is expressed at different levels. In addition, we identified two RACK1 ligands in *Symbiodinium*, by the Yeast-Two Hybrid System. The two identified proteins showed sequences that did not yield homologues from other species upon BLAST analysis against the GenBank. This suggests that the identified proteins are novel and may have specific functions in *Symbiodinium* through RACK1 interaction. It will be of great interest to characterize these proteins to determine their possible roles in growth and/or symbiosis.

Los arrecifes de coral son los ecosistemas más valiosos de la Tierra, pues sostienen más especies por unidad de área que cualquier otro ambiente marino. Los corales establecen una asociación endosimbiótica con algas dinoflageladas unicelulares del género *Symbiodinium*. El interés en comprender los mecanismos biológicos de esta simbiosis ha incrementado en las últimas décadas debido al aumento en frecuencia y severidad de los eventos de blanqueamiento de coral. El blanqueamiento del coral es el resultado de la disociación de la simbiosis Coral-S*ymbiodinium*, que puede ser provocada por aumentos en la temperatura del mar. Nuestra investigación se enfoca en la identificación de las vías de transducción de señales que puedan potencialmente regular el ciclo de vida y/o interacciones simbióticas de Symbiodinium con sus hospederos, usando como modelo de estudio de las relaciones Cnidario-dinoflagelado, a la medusa *Cassiopea xamachana*. Hemos identificado y caracterizado la proteína RACK1 (por sus siglas en inglés: Receptor for the Activated C Kinase), eje en varias vías de señalización. Amplificamos, clonamos y secuenciamos el transcrito y genes que codifican a RACK1 de Symbiodinium microadriaticum (SmicRACK1), y la cuantificación del transcrito por qRT-PCR de varias

etapas del ciclo de crecimiento en cultivo y de su ciclo de luz/obscuridad reveló acumulación diferencial. Además, identificamos dos ligandos de la proteína SmicRACK1 por el Sistema de Doble Híbrido en levadura. Las dos proteínas identificadas no tuvieron homólogos en otras especies después de análisis por BLAST en el GenBank, lo que sugiere que son proteínas novedosas y podrían desempeñar una función específica de Symbiodinium a través de interacciones con RACK1. Será muy importante caracterizar a estas proteínas para determinar su posible papel en crecimiento y/o simbiosis.

Keywords: Expression, qRT-PCR, RACK1, *Symbiodinium microadriaticum*, Yeast-Two Hybrid

THE INFLUENCE OF THE GEOMORPHOLOGY OF CORAL REEFS ON THE DISTRIBUTION OF *ACROPORA* SPECIES AROUND LITTLE CAYMAN, CAYMAN ISLANDS

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Acropora species are vital in Caribbean reef ecosystems due to the valuable services they provide such as habitat protection for commercially fished species and thousands of other species, high calcification (sink for CO_2), and coastal protection. Since the 1980s, populations have severely declined in the Caribbean. In order to focus transplant/ restoration efforts, increased survivorship, and increased population distribution and cover, a better understanding of the habitat preferences of these species is needed. As part of an NSF-funded REU program at the Central Caribbean Marine Institute, Acroporids were surveyed across 17 Little Cayman reefs to identify relationships between species metrics (i.e., abundance and colony size), and factors such as depth, distance from the adjacent trench wall, rugosity, and neighborhood biodiversity. Depth, distance from the wall, and rugosity were found to covary with the abundance of Acroporid species. *Acropora cervicornis* was also found to have common neighbors including *Porites* spp., *Agaricia agaricites*, Gorgonians, *Orbicella annularis*, and *Porites astreoides*. These findings can be applied to select reefs for outplanting efforts, potentially increasing transplant colony survivorship and optimizing resources.

Keywords: Acroporids, habitat, survivorship, Caribbean

MONITORING ALGAL AND SEAGRASS SPECIES DIVERSITY CHANGES IN A FRESHWATER-FLOODED, COASTAL WETLAND

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The Comprehensive Everglades Restoration Plan (CERP) is a federal effort to restore natural coastal wetlands and to counter rising salinity to historic levels. Deering Estate is conducting a flooding experiment to simulate potential effect of CERP's planned activities. This site was chosen as a pilot study site because it has multiple habitats in small scale, representative of coastal wetland areas in south Florida. The flooding of fresh water through the Deering Estate Flow Way is expected to drive changes in algal community structures through the potential increase of nutrient availability and modification of salinity in the near to shore habitats. The goal of our study is to provide a baseline and detect the first impacts of the flooding project in the close to shore habitats through the analysis of macroalgal diversity spatiotemporal variability and detect nutrient availability through the analysis of nutrient tissue content in macroalgal and seagrass species. Based on our survey of nine sites over a yearlong study, we have seen a shift in algal communities from marine tolerant species to estuarine tolerant species associated to changes in salinity and seasonal variability in all nine sites surveyed. Nutrient content shows that N and 15N are different across sites and species, with high values of N15 found in *Ulva* sp. and seagrasses at the sites near the canals where water is discharged, while lower values were found in the majority of algal species found in other sites. This pilot study provides a baseline for the species diversity and nutrient availability in the region. It is recommended to select species that are present in all sampling sites, and that are sensitive to the level of variability found between sites and seasons.

Keywords: macroalgae, monitoring, Florida, coastal, seagrass

MOLECULAR IDENTIFICATION OF SOLIERIACEAE SPECIES (RHODOPHYTA) IN THE YUCATAN PENINSULA, MEXICO

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The family Solieriaceae is the largest within the order Gigartinales comprising about 90 taxonomically accepted species in 19 genera. They are widely distributed in cold-temperate and tropical waters. Its representatives, in addition to being morphologically very variable, are characterized by a filamentous medulla and a pseudoparenchymatous cortex, zonated tetrasporangia and the presence of cystocarps in which the gonimoblast develops internally from an auxiliary cell. Additionally, most species constitute an important commercial resource due to the presence of carrageenans (family of linear sulphated polysaccharides, widely used in the food industry) in its cell wall. In the Yucatan Peninsula, eight species from seven genera have been previously recorded. However, these records do not include a morphological analysis of the species, so the morphological basis on which they were identified and the boundaries among them are unknown. In this work, we collected specimens of Solieriaceae from 10 localities of Campeche, Yucatan and Quintana Roo, which were morphologicaly characterized and molecularly analyzed using the *rbc*L and COI genes to separate them genetically. Our preliminary results show both, a pair of paraphyletic genera, as well as misidentifications and underestimation of the diversity of species of Solieriaceae for the Yucatan Peninsula. A new species of *Meristotheca* has been described and a new genus with two species are in the process of being described. These results highlight the need to carry out diversity studies integrating molecular tools in addition to the morphological characterization to generate a more reliable species identification, especially in these algae groups of high economic value, in which multi-variate taxonomic approaches have been rarely used.

La familia Solieriaceae es la más numerosa del orden Gigartinales, comprende cerca de 90 especies taxonómicamente aceptadas en 19 géneros, que se distribuyen ampliamente en aguas templadas y tropicales. Sus representantes, además de ser morfológicamente muy variables, se caracterizan por presentar una médula filamentosa y una corteza pseudoparenquimatosa, tetrasporangios zonados y la presencia de cistocarpos en los cuales el gonimoblasto se desarrolla internamente a partir de una célula auxiliar. Adicionalmente, la mayoría de sus representantes constituyen un importante recurso comercial por la presencia de carragenanos (familia de polisacáridos sulfatados lineales, ampliamente utilizadas en la industria alimentaria) en su pared celular. En la Península de Yucatán, han sido registradas ocho especies de siete géneros. Sin embargo, dichos registros no incluyen un análisis morfológico de las especies, por lo que se desconoce la base morfológica sobre la que fueron identificadas y los límites entre ellas. Para la elaboración de este trabajo, se recolectaron especímenes de Solieriaceae en 10 localidades de un Campeche, Yucatán y Quintana Roo, mismos que además de ser caracterizados morfológicamente, fueron sometidos a un análisis molecular, utilizando los genes *rbc*L y COI para identificarlos genéticamente. Nuestros resultados han

revelado, hasta el momento, tanto un par de géneros parafiléticos, como identificaciones erróneas y subestimación de la diversidad de especies de Solieriaceae para la Península de Yucatán. Asimismo, se ha descrito una nueva especie de *Meristotheca* y están en proceso de ser descritas un nuevo género con dos especies. Estos resultados, ponen de manifiesto la necesidad de realizar estudios de diversidad que integren herramientas moleculares, además de la caracterización morfológica, para generar identificaciones más confiables, especialmente en estos grupos de algas de alto valor económico, en los que los enfoques taxonómicos multivariados han sido poco utilizados.

Keywords: diversity, molecular characters, phylogeny

RUGOSITY CHARACTERIZATION ON REEF ENVIRONMENTS AND ITS IMPLICATIONS FOR BEACH PROTECTION SERVICES.

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Recent studies have demonstrated the importance of rugosity (i.e. structural complexity) in wave energy dissipation and in lagoon water circulation. However, to measure and characterize rugosity in these systems present important technical, logistic and conceptual challenges, including extreme water motion (breaking waves), shallowness, coral fragility and scale dependency. Therefore, the selection of a suitable method within the variety of existing possibilities is very important. In the present study cross-reef bathymetric profiles were performed in a ~25 km long reef system between Puerto Morelos and Cancun cities (Quintana Roo, Mexico) by means of a small catamaran (dimension: 2x1.5 m) equipped with ADCP-Echosounder, differential GPS, and video-camera. After correction by waves, the bathymetric signal was used to evaluate structural complexity with different methodologies, in order to compare results: traditional (dimensionless) rugosity index (RI), standard deviation-based estimates (SD), spectral analysis, fractal-dimension, and Wavelets were used. This measurement method is easy to apply and reproduce. Wavelet analysis was the preferred option, since it is capable of evaluating rugosity height and length (scales 0.3 to 30 m), and its spatial location along the profile. Therefore, this analysis is adequate to find relationships between bottom rugosity and hydrodynamic phenomena at different scales. The other interesting index was the SD that can be related directly with the size of the biggest objects (coral colonies) on the profile. Using the ADCP and GPS data, an estimate of the velocities and the wave dissipation across the reef is also possible to obtain. All estimates showed that the back reef has the highest rugosity for the area. This has strong implications for beach protection as shown with numerical modeling of wave attenuation. Reef structural complexity, continuity of the barrier, and proximity to shore are the main parameters that affect beach dynamics. This information should be considered when planning beach developments in reef-fronted areas.

Estudios recientes han demostrado la importancia de la rugosidad en la disipación de energía de oleaje y en la circulación de sistemas lagunares. Sin embargo, medir y expresar la rugosidad en estos sistemas implica desafíos técnicos, logísticos y conceptuales, por ejemplo, el rápido movimiento del agua en la zona de rompiente, el difícil acceso a las zonas someras, la fragilidad del coral y la dependencia de la rugosidad a la escala. Por ello, la elección de un método adecuado dentro de la gran variedad existen es una tarea difícil e importante a la vez. En el presente estudio se obtuvieron perfiles perpendiculares a la costa en el sistema arrecifal ubicado entre la ciudades de Cancún y Puerto Morelos (aprox. 25km), para ello su utilizó un catamarán (dimensión aprox. = 2x1.5m) equipado con un ADCP-ecosonda, GPS diferencial y una videocámara. Después de realizar una corrección para eliminar el oleaje, la señal de batimetría fue usada para evaluar la rugosidad con las siguientes técnicas: índice tradicional de rugosidad, desviación estándar (DE), análisis espectral, dimensión fractal y análisis

Wavelet. El método de medición (catamarán-ecosonda) muestra ser fácil de implementar y reproducible. En cuanto a las técnicas de análisis, solo el Wavelet permitió obtener tanto la altura como la longitud de rugosidad a diferentes escalas (0.3 a 30m), además de su ubicación espacial a lo largo del perfil, por ello esta técnica es la más adecuada para relacionar a la rugosidad con los fenómenos hidrodinámicos. Otro interesante índice fue la DE que puede relacionarse con la altura de los objetos (colonias de coral) encontrados sobre el perfil. Usando el ADCP y GPS se pueden obtener estimaciones de las velocidades y disipación del oleaje a través del arrecife. Con todos los estimadores, el arrecife posterior resultó ser el más rugoso, lo cual tiene fuertes implicaciones en la protección de playas, esto también fue sustentado mediante modelación numérica. La rugosidad del arrecife, la continuidad de la barrera y la proximidad de está a la costa son los principales parámetros que afectan la dinámica de playas. Esta información debe ser considerada en planes de desarrollo costero cuando hay sistemas arrecifales implicados.

Keywords: Coral-Reefs Roughness Bathymetry Wavelets

CALCIFICATION OF LARVAE OF *STROMBUS (L.) GIGAS* IN THE CARIBBEAN.

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Monthly from July to September, five sites of the Greater Caribbean were sampled in Puerto Morelos, Florida, Dominican Republic, Guadeloupe and Barbados. The aim of this study was to analyze the larval calcification of *Strombus (Lobatus) gigas* throught the Caribbean. From the NOAA were taken daily data average of temperatures (° C), salinity (UPS), dissolved oxygen (mg l-1), chlorophyll concentration (mg m-3). Larvae of *S. (L.) gigas* were identified and measured (siphonal length µm). ESEM-Philips XL30 Scanning Electron Microscope was used for calcium analysis). Average siphonal length of larvae analysed was 421.35 ± 143.09 µm. The Calcium average was 12.75 ± 8.21 (n= 51 larvae). The highest percentage was registered in the Dominican Republic and Barbados (16.67 ± 13.09% and 13.69 ± 6.84%, respectively). These larvae showed a sifonal length of 380.77 µm and 336 µm, respectively. The lowest calcium percentage was registered in Guadeloupe (6.74 ± 0.0% and length 664 ± 0.0 µm). Larvae sampled in July showed the highest calcium percentage (13.03 ± 8.57%) and the lowest was observed in August with 9.8 ± 4.24. No significant difference was found among sites (KW, n = 51, g.l.4, H 4.19, p 0.3809) and months (KW, g.l.2, H 0.59, p 0.7437).

Mensualmente de julio a septiembre, cinco sitios en el Gran Caribe fueron muestrados: Puerto Morelos, Florida, República Dominicana, Guadalupe y Barbados. El objetivo de este estudio fue analizar la calcificación en larvas de Strombus (Lobatus) gigas a través del Caribe. De la Base de datos de la NOAA se obtuvieron los promedios diarios de temperatura (° C), salinidad (UPS), oxígeno disuelto (mg l-1), concentración de clorofila (mg m-3). Las larvas de S. (L.) gigas fueron identificadas y medida (longitud sifonal µm). Se utilizó un Microscopio Electrónico de Scaneo SEM-Philips XL30 para el análisis de Calcio. La longitud sifonal promedio de las larvas analizadas fue 421.35 ± 143.09 µm. El porcentaje de Calcio fue 12.75 ± 8.21 (n= 51 larvae). Los porcentajes más altos se registraron en la República Dominicana y en Barbados (16.67 ± 13.09% y 13.69 ± 6.84%, respectivamente). Estas larvas registraron una longitud sifonal de 380.77 µm y 336 µm, respectivamente. El porcentaje de Calcio más bajo se registró en Guadalupe (6.74 ± 0.0% y longitud sifonal 664 ± 0.0 µm). Las larvas muestreadas en julio registraron el porcentaje más alto de Calcio (13.03 ± 8.57%) y el más bajo fue observado en agosto (9.8 ± 4.24). No se encontró diferencia significativa entre sitios (KW, n = 51, g.l.4, H 4.19, p 0.3809) ni entre meses (KW, g.l.2, H 0.59, p 0.7437).

Keywords: Calcificación, *Strombus (L.) gigas*, Caribe

TWENTY-TWO YEARS OF SEAGRASS MONITORING AT THE PUERTO MORELOS CARICOMP SITE: DISCERNING NATURAL AND HUMAN-INDUCED CHANGES

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During the summer and winter from 1993 to 2015, the community structure of the seagrass beds and foliar dynamics of the dominant seagrass *Thalassia testudinum* were determined at four sites in the Puerto Morelos reef lagoon, Mexican Caribbean following the CARICOMP protocol. Interannual fluctuations in parameters of the community and foliar dynamics of *T. testudinum* could not be associated with naturally occurring events, such as heavy rains or high temperature periods. Patterns of change were gradual, with significant increase in total above-ground biomass of *Syringodium filiforme* and fleshy algae. *T. testudinum* and *S. filiforme* invested proportionally more biomass in above-ground leaf tissues. Three minor hurricanes had no detectable impacts on seagrass beds, but Wilma (October 2005) changed the community composition at three stations and buried completely the coastal station. It is probably that gradual changes in the seagrass community recorded in 22 years of monitoring in the CARICOMP site reflect the increased pollution caused by the rapid increase in urban and tourism developments in Puerto Morelos, coupled with poor water management services.

Keywords: seagrass, *Thalassia*, environmental monitoring, eutrophication

THE POTENTIAL FOR NON-SCLERACTINIAN HOSTS TO ACT AS *SYMBIODINIUM* RESERVOIRS

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Symbiont type is important in enabling hosts to partially mitigate the detrimental effects of global climate change. Spatial variations in *Symbiodinium* communities available to hosts could have implications for the ability of reef communities to respond to environmental stressors. However, little is known about how symbioses with non-scleractinians (i.e. gorgonians, octocorals etc.) are distributed over large spatial scales, and how these assemblages contribute to this environmental pool. Using a meta-analysis approach, we assessed the pan-Caribbean diversity of *Symbiodinium* associated with scleractinian and non-scleractinian hosts. Although scleractinian associated *Symbiodinium* assemblages exhibit biogeographic partitioning, non-scleractinian associated *Symbiodinium* assemblages are largely spatially consistent across the Caribbean. This divergence in distribution as well as evidence of shared symbiont diversity between host types suggests that non-scleractinian hosts may act as a reservoir of *Symbiodinium* diversity across the Caribbean, and the availability and diversity of these reservoirs is driven by the distributions of these hosts.

El tipo de simbionte puede permitir a su huésped mitigar parcialmente los efectos perjudiciales del cambio climático. Las variaciones espaciales en comunidades de Symbiodinium podrían afectar la capacidad de los arrecifes para responder a factores de estrés ambiental. Sin embargo, existe poca información sobre la distribución de las asociaciones de Symbiodinium con organismos no-escleractínidos (e.g. gorgonias, octocorales etc.) sobre grandes escalas espaciales, y la contribución de estas comunidades a la reserva ambiental. Evaluamos por medio de técnicas de meta-análisis, la diversidad pan-Caribeña del Symbiodinium asociado a huéspedes escleractínidos y no-escleractínidos del arrecife, además de otros tipos de vida libre. Aunque las agrupaciones de Symbiodinium y coral escleractínido exhiben una división biogeográfica, en su mayoría, la distribución de las asociaciones de Symbiodinium con otros huéspedes es consistente a lo largo de la región. Esta divergencia en distribución, junto con la evidencia de la diversidad compartida del simbionte entre distintos tipos de huésped, sugiere que los organismos no-escleractínidos podrían servir como una reserva de diversidad de Symbiodinium en el Caribe, y la disponibilidad y la diversidad de estas reservas son determinadas por la distribución del organismo huésped.

Keywords: *Symbiodinium*, biogeography, meta-analysis, reservoir, Caribbean, community

FINDING THE NEEDLE IN THE HAY STACK. USE OF THE CNIDARIAN MODEL SYSTEM, *EXAIPTASIA PALLIDA* TO SCREEN POTENTIAL DISEASE CAUSING PATHOGENS IN CORALS

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Caribbean coral reefs are rapidly declining due partially to increased disease outbreaks. One of the major diseases effecting scleractinian corals is White Plague Disease (WPD). In the late 90s, the causative agent for WPD was demonstrated to be *Aurantimonas coralicida* however, this pathogen has no longer been associated with later re-appearances of similar signs of WPD affecting corals along the Florida Reef Tract. There is a current urgency to discover the causative agent of this disease so that remediation plans can be designed to treat diseased corals in future outbreaks. This study used the sea anemone, *Exaiptasia pallida* to test pathogenicity of bacterial isolates derived from WPD lesions. The use of the sea anemone model allowed for rapid screening of potential pathogens and narrowed down candidate causative agents that could be tested on coral samples. A total to 33 bacterial isolates were tested on *E. pallida* at a final bacterial concentration of 10^8, 10^7, and 10^6 CFU/ml. Challenge experiments occurred over 5 days at 30˚C in triplicate. Out of the 33 isolates, 11 bacterial strains did not cause anemone mortality regardless of bacterial inoculation concentration. Twenty two bacterial isolates caused mortality at different rates at 10^8 CFU/ml. Three isolates caused 100% mortality after 48 hours from the inoculation. Six additional bacterial isolates caused 100% mortality after longer periods of exposure (72 -120 hours). The varied response of *E. pallida* to different bacterial strains suggests that some strains are more pathogenic than others. We showed that this sea anemone is a cost-effective surrogate to pre-screen microbial agents to identifying potential pathogens affecting corals. Thus, the use of coral material for microbiological testing is considerably reduced. In the future, the most virulent isolates will be tested on coral samples to determine which challenges recreate the signs of WPD.

Keywords: Coral Disease, White Plague Disease, *Exaiptasia pallida*, corals, microbiology, bacterial pathogen screening

POTENTIAL IMPACTS OF CLIMATE CHANGE IN REPRODUCTIVE PHENOLOGY OF ECONOMICALLY IMPORTANT FISHES FROM SOUTHERN GULF OF MEXICO.

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Increments in sea temperature and dissolved carbon dioxide concentrations (CO2), changes in circulation patterns of marine currents and the occurrence of extreme meteorological conditions are principal climate change outcomes affecting marine fish populations. These disturbances may be the result of alterations produced in individual, population or even ecosystem levels. Water temperature is one fundamental physical factor that controls phenological events in fishes such as reproduction and early life stages development. Increments in temperature alter the endocrine system and induce stress, and thus inhibiting sex steroids production. As a consequence, overall reproduction may be suspended and sexual cycle, sexual determination and sexual transition (for sequential hermaphroditic species) affected. Potentially serious consequences of temperature and CO2 rising are that they can affect embryonic and larval development, and moreover, impairment of olfactory sensitivity and changes in behavior of larval fish. In southern Gulf of Mexico, in the continental platform surrounding the Yucatan Peninsula (Campeche Bank), groupers (Epinephelidae, Epinephelini), snappers (Lutjanidae) and wrasses (Labridae) are heavily exploited as one of the most important fishery resources in Mexico. These fishes drift during its life cycle from a three-dimensional pelagic realm (embryos and larvae) to a two-dimensional demersal one (juveniles and adults). Therefore they are more sensitive to clime change outcomes that could display different effects according to their type of sexuality, reproductive seasonality, spawning behavior and connectivity between essential habitats. Consequently, climate change may be an additional threat to the already overexploited populations.

El incremento de la temperatura y del dióxido de carbono (CO2) disuelto en los océanos, la alteración de los patrones de circulación de las corrientes marinas, así como la ocurrencia de eventos meteorológicos extremos son las principales consecuencias del cambio climático que afectan las poblaciones de peces marinos. Los efectos pueden manifetarse como perturbaciones al nivel del individuo, de la población o del ecosistema. La temperatura es un factor físico fundamental que regula los eventos fenológicos relacionados con los procesos de reproducción y de desarrollo temprano de los peces. El incremento de temperatura afecta directamente al sistema endocrino de los organismos e induce un estado de estrés en los individuos, provocando una disminución en la producción de esteroides sexuales. Como consecuencias la reproducción puede detenerse y el ciclo sexual, los procesos de determinación sexual y de inversión sexual (caso de especies hermafroditas sucesivas) pueden ser afectados. Las

temperaturas elevadas afectan también el desarrollo embrionario y larvario y los valores elevados de presión parcial en CO2 producen una deterioración de la sensibilidad olfativa y un cambio de comportamiento de las larvas. En el sur del Golfo de México, sobre la extensa plataforma continental de la Península de Yucatán (Banco de Campeche), los meros (Epinephelidae, Epinephelini), pargos (Lutjanidae) y doncellas (Labridae) constituyen uno de los recursos pesqueros más importantes para México. Estas especies cuyos individuos transitan durante su ciclo de vida de un ambiente pelágico tridimensional (fases embrionaria y larvaria) a uno demersal bidimensional (fases juvenil y adulta), pueden ser afectadas de diversas maneras por los efectos del cambio climático según el tipo de sexualidad que exhiben, la estación del año durante la cual se reproducen, el comportamiento de desove que presentan y el nivel de conectividad requerido entre sus hábitats esenciales. Aunado a la pesca, el cambio climático puede entonces constituir un factor suplementario que altere la producción pesquera, en particular cuando las especies ya se encuentran sobreexplotadas.

Keywords: Global warming, reproduction, teleosts, fisheries

HARMONIZING MARINE AND TERRESTRIAL PALEOCLIMATE ARCHIVES TO BETTER UNDERSTAND CARIBBEAN CLIMATE DYNAMICS

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In the Caribbean, attribution of climatic change to both natural and anthropogenic causes is hampered by short and fragmented meteorological records which do not capture longer-term natural climate variability. To address the need for longer climate records, paleo-environmental scientists extend the instrumental climate record back in time using proxy-based data recovered from natural marine and terrestrial archives. However, comparisons between natural archives are often complicated by differences in accumulation rates and temporal resolution, and also in the methods used to date the archives. In order to improve our understanding of the ocean-atmosphere interactions in the Caribbean, we applied simple statistical techniques to harmonize the chronology of coral-based sea surface temperature record from the Western Caribbean and a mangrove-lagoon sediment archive from Jamaica. Subsequent comparisons between coral-based reconstructions of SST and lake level change, and meteorological records of hurricane activity, revealed statistically significant relationships between these variables for the period AD 1773-2008. Given these relationships, we developed a sediment-based, hurricane activity index, which suggested that hurricane activity likely increased in the Western Caribbean during periods of low natural radiative forcing and decreased during the warmer mean climate states of the last millennium. A gradual increase in Atlantic hurricane activity during the industrial period (ca. 1870-present) is probably a response to a combination of natural- and human-induced forcing factors. Thus, the ability to better constrain the lower-resolution chronologies that characterize mangrove lagoon sediments with their high-resolution coral counterparts, provides new research opportunities to improve our understanding of the nature and timing of the different climate cycles recorded within the Caribbean paleoclimate archives.

Keywords: Caribbean, Paleoclimate, Coral, Mangrove lagoon, SST, Hurricanes

UPDATE ON REEF REPLENISHMENT EFFORTS IN BELIZE: SUCCESS INDICATORS AND EXPANSION PLANS

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Coral restoration efforts have been ongoing in Belize for over a decade now. Results from acroporid restoration work at Laughing Bird Caye National Park, Belize are shared here, where over 70,000 nursery-grown acroporid fragments have been out-planted in ~ one hectare of degraded reef in an effort to conserve biodiversity and restore tourism value to this popular and heavily visited site. Success indicators include longevity, genetic diversity, bleaching resilience, reproductive indicators, increases of live acroporid cover from zero to over 35%, changes in fish biomass on out-planted sites, and direct local community engagement via a training course vetted by the Belize Fisheries Department. Updates include expansion efforts to South Silk and Moho Caye in southern Belize (over 10,000 corals outplanted at each caye), and new nurseries installed in South Water Caye Marine Reserve (four) and Turneffe Atoll Marine Reserve (three). Additional updates include methods to assess micro-scale biodiversity by deploying Autonomous Reef Monitoring Structures (ARMS), and new techniques for micro-fragmenting 'slower growing' species such as star, brain and pillar corals. These two methods have been used elsewhere, but are modified for use in Belize. The ARMS units, developed by Dr. Nancy Knowlton, will compare biodiversity in replenished and un-replenished sites, both inside and outside of MPAs, on shallow fringing reefs. The micro-fragmenting technique (developed Mote Marine Laboratory) was modified for in situ execution (no initial period in aquariums or tanks). Micro-fragmentation is effective for massive as well as branching corals so if successful, this method could revolutionize reef replenishment efforts in Belize and the Caribbean that have traditionally focused primarily on the faster growing acroporids.

Los esfuerzos de restauración de corales han estado en curso en Belice desde hace más de una década. Aquí se comparten los resultados de los trabajos de restauración acroporidos en el Parque Nacional de Laughing Bird Caye, Belice, donde se han sembrado más de 70.000 fragmentos acroporidos en una hectárea de arrecife degradado en un esfuerzo por conservar la biodiversidad y restablecer el valor turístico de este popular Y sitio muy visitado. Los indicadores de éxito incluyen la longevidad, la diversidad genética, la resiliencia del blanqueo, los indicadores reproductivos, el aumento de la cobertura acroporida en vivo de cero a más del 35%, los cambios en la biomasa de peces en los sitios sembrados y el compromiso directo de la comunidad local mediante un curso de capacitación aprobado por Belize Fisheries Departamento. Las actualizaciones incluyen esfuerzos de expansión a South Silk y Moho Caye en el sur de Belice (más de 10.000 corales plantados en cada cayo), y nuevos viveros instalados en la Reserva Marina South Water Caye (cuatro) y Turnoffe Atoll Marine Reserve (tres). Actualizaciones adicionales incluyen métodos para evaluar la biodiversidad a microescala mediante la implementación de estructuras de monitoreo de arrecifes autónomos (ARMS), y nuevas técnicas para micro-fragmentar especies de 'crecimiento lento' como corales estrella, cerebro y pilar. Estos dos métodos se han utilizado en otros lugares, pero se han

modificado para su uso en Belice. Las unidades ARMS, desarrolladas por la Dra. Nancy Knowlton, compararán la biodiversidad en sitios repoblados y no regenerados, tanto dentro como fuera de las AMPs, en arrecifes de franjas poco profundas. La técnica de micro-fragmentación (desarrollada Mote Marine Laboratory) se modificó para la ejecución in situ (sin período inicial en acuarios o tanques). La microfragmentación es efectiva tanto para los corales masivos como para los ramificados, por lo que si tiene éxito, este método podría revolucionar los esfuerzos de reposición de arrecifes en Belice y el Caribe, que tradicionalmente se han enfocado principalmente en los acroporidos de mayor crecimiento.

Keywords: Caribbean reef restoration, success indicators, biodiversity

DIFFERENTIAL PHOSPHORYLATION OF A HSP-LIKE PROTEIN FROM CULTURED *SYMBIODINIUM* UNDER VARIOUS LIGHT CONDITIONS

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Symbiodinium microalgae belong to a genus of photosynthetic dinoflagellates that usually live as endosymbionts in marine invertebrates such as anemones, jellyfish and corals. However, they are also able to live independently outside their host as planktonic organisms. Due to their photosynthetic ability, they are sensitive to changing light conditions in the marine environment. Thus, light-sensing mechanisms are of utmost importance in responding to environmental changes in these organisms. We have identified a HSP-like protein from cultured *Symbiodinium microadriaticum* with a mass of ~75 kDa which is phosphorylated on threonine after 12 hours of continuous darkness. The original level of phosphorylation decreased when the *Symbiodinium* cells were exposed to light for about 30 min, regardless of the intensity. Upon exposure to different types of light, we observed a lower effect on the level of dephosphorylation by exposure to blue light compared to red. In addition, we examined the effect on dephosphorylation of the protein upon light exposure after incubating the cells at 26, 32 and 36°C. Interestingly, light-induced dephosphorylation was only detected at 26°C and no changes in phosphorylation levels at the higher temperatures of 32 or 36°C were observed. Finally, 2D-PAGE analysis revealed that this protein displays two isoforms likely due to differential phosphorylation. We are currently focusing on raising antibodies to this protein to study its changes in expression and compare them to changes in the level of phosphorylation under different light conditions. This will also allow us to determine its subcellular localization and identification of associated ligands. These studies will bring knowledge on the specific function of this protein in the *Symbiodinium* light-induced responses.

Las microalgas de *Symbiodinium* pertenecen a un género de dinoflagelados fotosintéticos que habitualmente viven como endosimbiontes dentro de invertebrados marinos tales como anémonas, medusas y corales. Sin embargo, también son capaces de vivir independientemente fuera del huésped como organismos planctónicos. Debido a su capacidad fotosintética son sensibles a las condiciones cambiantes de luz del medio ambiente marino. Por ello, los mecanismos de detección de luz son de suma importancia para responder a los cambios medioambientales en estos organismos. Hemos identificado una proteína tipo HSP de *Symbiodinium microadriaticum* en cultivo con un peso de ~ 75 kDa que está fosforilada en treonina después de 12 horas de oscuridad continua. El nivel original de fosforilación disminuyó cuando las células de Symbiodinium fueron expuestas a la luz durante 30 min, independientemente de la intensidad lumínica. Tras la exposición a diferentes tipos de luz, se observó un menor efecto en el nivel de desfosforilación con luz azul que con roja. Adicionalmente, examinamos el efecto en la desfosforilación de la proteína tras la exposición a la luz, después de incubar las células a 26, 32 y 36°C. Interesantemente, la desfosforilación inducidad por luz solamente se

detectó a 26°C y no se observaron cambios en los niveles de fosforilación a las temperaturas mayores de 32 o 36°C. Por último, análisis en geles de 2D-PAGE revelaron dos isoformas de la proteína, probablemente debidas a una fosforilación diferencial. Actualmente nos estamos enfocando en la obtención de anticuerpos específicos para esta proteína que nos permitirán estudiar los cambios de expresión y compararlos con los cambios del nivel de fosforilación bajo diferentes condiciones de luz. Los anticuerpos también nos permitirán determinar su localización subcelular e identificar ligandos asociados. Estos estudios arrojarán conocimiento importante sobre la función específica de esta proteína en las respuestas inducidas por luz de *Symbiodinium*.

Keywords: Heat Shock Protein, light response, phosphorylation, *Symbiodinium*, temperature effect

COST-BENEFIT ANALYSIS OF RESTOCKING STAGHORN CORAL (*ACROPORA CERVICORNIS*) POPULATIONS ON THE FLORIDA REEF

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Staghorn coral (*Acropora cervicornis*) populations have experienced extreme declines in the SE Atlantic/Caribbean over the last four decades. Evidence suggests restocking depleted staghorn populations with nursery propagated colonies may increase the likelihood of long-term species recovery. Implementing marine reserves to protect restored coral reefs may improve the chances of survival for outplanted staghorn colonies and recruitment of new colonies. A greater understanding of the ecological dynamics and economics of coral reef restoration is required, as is consideration of alternative management options, to determine whether, and under what conditions, large scale coral reef restoration and protection are effective uses of available resources. This research will employ an Ecosystem Services (ES) framework to estimate the Return on Investment (ROI) from restocking and protecting staghorn coral populations off Florida. The study will consider four important coral reef associated ES, namely support of commercial fisheries, support of recreational opportunities, support of cultural, religious, or spiritual values, and coastal storm protection. To examine the commercial fishery value of reef restoration and protection, we develop a bioeconomic model that simulates changes in the long-run equilibrium of reef-supported harvestable fish stocks and optimal annual harvesting rates under alternative restocking and protection regimes. Public preferences for restocking and protecting staghorn populations along the Florida Reef will be elicited and people's willingness-to-pay (WTP) for enhanced staghorn associated ES will be estimated through a web-based Discrete Choice Experiment (DCE). Aggregating these values will enable estimation of the incremental and Total Economic Value (TEV) of restocking staghorn corals. This general valuation framework linking coral protection and fisheries ecosystem services will provide policy and decision makers with straightforward metrics to evaluate alternative recovery actions.

Las poblaciones de coral cuerno de ciervo (*Acropora cervicornis*) han experimentado disminuciones extremas en el Atlántico sureste / Caribe durante las últimas cuatro décadas. La evidencia sugiere que la repoblación de poblaciones de coral cuerno de ciervo agotadas con colonias propagadas en vivero puede aumentar la probabilidad de recuperación a largo plazo de especies. La implementación de reservas marinas para proteger los arrecifes de coral restaurados puede mejorar las posibilidades de supervivencia de las colonias de staghorn plantadas y el reclutamiento de nuevas colonias. Se requiere una mayor comprensión de la dinámica ecológica y económica de la restauración de los arrecifes de coral, así como la consideración de alternativas de manejo para determinar si, y bajo qué condiciones, la restauración y protección de arrecifes de coral a gran escala son usos efectivos de los recursos disponibles. Esta investigación empleará un marco de Servicios de Ecosistemas (SE) para estimar el Retorno de la Inversión (RI) de la repoblación y protección de las poblaciones de corales cuerno de ciervo fuera de la Florida. El estudio considerará cuatro importantes SE relacionados con

los arrecifes de coral, a saber, el apoyo a las pesquerías comerciales, el apoyo a las oportunidades recreativas, el apoyo a los valores culturales, religiosos o espirituales y la protección contra las tormentas costeras. Para examinar el valor de la pesquería comercial de la restauración y protección de los arrecifes, desarrollamos un modelo bioeconómico que simula cambios en el equilibrio a largo plazo de las poblaciones de peces cosechables respaldadas por arrecifes y tasas óptimas de cosecha anual bajo regímenes alternativos de repoblación y protección. Se obtendrán las preferencias públicas para el repoblamiento y protección de las poblaciones de estafilocales a lo largo del arrecife de Florida, y se estimará la disposición de las personas a pagar para SE mejorado. La agregación de estos valores permitirá estimar el incremento y el valor económico total de la repoblación de corales cuerno de ciervo. Este marco general de valoración que vincula la protección de los corales y los servicios ecosistémicos de las pesquerías proporcionará a los responsables de las políticas ya los encargados de la adopción de decisiones indicadores sencillos para evaluar las acciones alternativas de recuperación.

Keywords: Staghorn, Cost-Benefit, Cervicornis, Restoration, Discrete-Choice Experiment

SEASONAL RECRUITMENT AND SURVIVAL STRATEGIES OF *PALISADA CERVICORNIS COMB*. NOV. (CERAMIALES, RHODOPHYTA) IN CORAL REEFS

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As marine tropical ecosystems deteriorate and lose biodiversity, their communities are shifting to dominance of few species, altering ecosystem's functioning and services. Macroalgae are a group of species that are becoming dominant on coral reefs and are frequently found overgrowing and outcompeting corals. Turf algal assemblages are the base of energy flow in the system and one of the most abundant types of macroalgae on coral reefs, but little is known about their biology and diversity. Through a molecular and morphological study, we established the proper identity of the turf forming species *Laurencia cervicornis*, and by studying seasonal recruitment and the impact of herbivorous fishes on its abundance, we describe its survival strategy. The molecular analysis using a total of 45 rbcL sequences including eight current genera of the *Laurencia* complex and two newly sequences of *L. cervicornis*, strongly support its nomenclature status adjustment to *Palisada cervicornis comb*. nov. , and a detailed morphological description of the species, including the description of reproductive structures is provided. *P. cervicornis* was found recruiting in all seasons but was typically in low abundance. Specimens, grown in tiles on fish exclosure cages, were devoured in less than 4 hours when offered to fishes. Even though many species of the *Laurencia* complex have chemicals that deter herbivory, species of the genus *Palisada* lack feeding deterrents and are highly palatable. Based on our results, we suggest that P. cervicornis finds refuge in turf assemblages, where it is continually cropped by herbivores but not completely consumed.

A medida que los ecosistemas tropicales marinos se deterioran y pierden biodiversidad, sus comunidades están siendo dominadas por pocas especies, alterando el funcionamiento y los servicios del ecosistema. Las macroalgas son un grupo de especies que se están convirtiendo en dominantes en los arrecifes de coral y con frecuencia se encuentran desplazan los corales. Los conjuntos de algas formadoras de césped son la base del flujo de energía en el sistema y uno de los tipos más abundantes de macroalgas en los arrecifes de coral, pero poco se sabe sobre su biología y diversidad. A través de un estudio molecular y morfológico, establecimos la identidad taxonómica de la especie formadora de césped *Laurencia cervicornis*, y estudiando el reclutamiento estacional y el impacto de los peces herbívoros sobre su abundancia, describimos su estrategia de supervivencia. El análisis molecular utilizando un total de 45 secuencias de rbcL incluyendo ocho géneros actuales del complejo *Laurencia* y dos nuevas secuencias de *L. cervicornis*, apoyan fuertemente su ajuste nomenclatural a *Palisada cervicornis comb*. nov., además se proporciona una descripción morfológica detallada de la especie, incluyendo la descripción de las estructuras reproductivas. Reclutas de *P. cervicornis* fueron encontradas en todas las estaciones, pero con abundancia baja. Los especímenes crecidos

en placas de reclutamiento dentro de jaulas para evitar ser consumidos, fueron devorados en menos de 4 horas cuando fueron ofrecidos a los peces. A pesar de que muchas especies del complejo Laurencia tienen productos químicos que disuaden la herbivoría, las especies del género Palisada carecen de estos compuestos y son altamente consumidas. Basándonos en nuestros resultados, sugerimos que P. cervicornis encuentra refugio en las asociaciones de céspedes, donde es continuamente recortada por herbívoros, pero no completamente consumida.

Keywords: Algal recruitment, herbivory, *Palisada cervicornis*, rbcL, taxonomy, turf algae.

THERMOHALINE DYNAMICS AND THE EFFECT OF EXTREME SALINITY GRADIENTS IN THE ICHTHYOFAUNA DISTRIBUTION IN A TROPICAL COASTAL LAGOON

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The coastal lagoon La Carbonera has important submarine groundwater discharges (SGD) and wide salinity ranges, which modify fish distribution. The hydrodynamics were studied through observations and numerical modeling. Five CTD sensors moored at strategic sites gathered temperature, salinity, and water level variations from September 2014 to September 2015. The Delft3D numerical model was implemented to assess the effect of wind, tides, temperature, and salinity and SGD in the currents and thermohaline fields. Salinity was related with the distribution of stenohaline ichthyofauna from an existing database of fish distribution (monthly data from 2009 to 2011 in 12 stations). The lagoon has 4 regions: hyperhaline (> 80, east), marine region (mouth), estuarine (west) and fresh (submarine spring). Currents are higher the west and central regions (dominated by tides which drive the advection of seawater and freshwater at the different tidal stages). The eastern region has low-magnitude currents and little water exchange. The saline fields change through the tidal cycle with larger fresh water excursion to the sea during low tides. During Northerly wind events, seawater reaches further into the wetland towards the south and east of the lagoon. During the dry season extremely high salinity values (>80) were recorded in the eastern side, which are diluted as the first rain events appear. Changes in salinity gradients may alter the distribution range of fish. Estuarine species (*Menidia colei*, *Sphyraena barracuda a*nd *Archosargus rhomboidalis*) have been observed in the southeast zone (marine and hipersaline) during Northerly storms. Freshwater species (*Gambusia yucatana*) are present in the estuarine zone. Events of seawater intrusion were observed at the spring mooring site and serve to explain the presence of marine species (*Paralichthys albigutta*) in the freshwater region. The daily and yearly variations of the currents and salinity fields determine the spatial distribution of stenohaline species of this lagoon system.

La laguna costera La Carbonera posee una importante descarga de aguas subterráneas y amplios rangos de salinidad, lo cual modifica la distribución de los peces. La hidrodinámica fue estudiada a través de observaciones y modelación numérica. Cinco sensores CTD ubicados en lugares estratégicos registraron temperatura, salinidad y variaciones del nivel del agua desde septiembre 2014 a septiembre 2015. El modelo numérico Delft3D fue implementado para evaluar el efecto del viento, mareas, temperatura, salinidad y descargas de agua subterráneas en las corrientes y patrones termohalinos. La salinidad fue relacionada con la distribución de la ictiofauna estenohalina a través de una base de datos de distribución de peces ya existente (datos

tomados mensualmente de 2009 a 2011 en 12 estaciones). La laguna presenta 4 regiones: hiperhalina (>80, este), región marina(bocana), estuarina (oeste) y agua dulce (descargas subterráneas). Las corrientes son mayores en las regiones centrales y oeste (influenciadas por las mareas, las cuales provocan la advección del agua marina y dulce en las diferentes fases mareales). La región este posee corrientes de baja magnitud y escaso intercambio de agua. Los patrones de salinidad cambian a través de los ciclos de marea, existiendo una mayor descarga de agua dulce hacia el mar durante las bajamares. Durante los eventos de vientos del Norte, el agua de mar alcanza sus mayores cotas hacia las zonas sur y este de la laguna. Durante la época de sequía se obtuvieron valores extremadamente altos de salinidad en la zona este de la laguna, los cuales disminuyeron al caer las primeras lluvias. Los cambios en los gradientes salinos afectan los ámbitos de distribución de los peces. Especies estuarinas (*Menidia colei, Sphyraena barracuda* y *Archosargus rhomboidalis*) fueron observadas en la zona sureste (marina e hiperhalina) durante las tormentas de componente norte. Las especies dulceacuícolas (*Gambusia yucatana*) están presentes en la zona estuarina. Fueron observados eventos de intrusión de agua marina en la zona de descarga de agua subterránea, lo cual sirve para explicar la presencia de especies marinas (*Paralichthys albigutta*) en la región de agua dulce. Las variaciones diarias y anuales de las corrientes y los patrones salinos determinan la distribución de las especies estenohalinas de este sistema lagunar.

Keywords: hydrodynamics, salinity, ichthyofauna, SGD

OBSERVER EFFECTS AND CALIBRATION IN UNDERWATER VISUAL SURVEYS OF FISH: A MULTIVARIATE APPROACH.

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Visual census is the main method used to assess coral reefs fish abundances. Independent of the method used, the effect of the observer on accuracy and precision is important. At a minimum, these effects increase the error term of quantitative analyses, which reduces statistical power. At worse, observer bias could cause serious problems affecting conclusions, a problem further exacerbated when considering studies of large spatiotemporal scales, where different surveyors do different locations/regions and/or different year/times. To minimize this issue, different training programs are recommended, coupled with calibration methods to estimate inter-observer variation. Most approaches to this calibration assume that perfect accuracy (i.e., identical estimates done by different but equally skilled surveyors) is impractical, and consequently, they focus on estimating inter-observer precision. They also typically used univariate estimates, such as total biomass, total number of species, abundance of the most important species, etc.; few have attempted to use the information contained in the entire data matrix (i.e., all biomass/abundances of all species present in the sampled assemblage). Here, we propose a calibration approach using a multivariate measure of dispersion (i.e. average distance of samples to the centroid). To test this, we performed a typical training/calibration protocol for fish surveys in the west coast of Puerto Rico, which consisted in repeated sampling (15 times) of two very well-known locations by 6 divers (2 experienced, 2 trained and 2 unexperienced fish surveyors). Our multivariate approach coupled with standard univariate estimators of precision showed that some of the biases normally encountered using univariate estimators only (e.g., different conclusions are reached using different species) were overcome by considering the entire sampled fish assemblage. We suggest that, when doing visual fish surveys, the use of multivariate estimators of dispersion, in addition to the univariate estimators, would improve overall interpretation of the observer effect.

Keywords: Fish assemblages, Surveys, Calibration, Monitoring

ULTRASTRUCTURAL AND MOLECULAR CHARACTERIZATION OF DIGESTIVE GLAND INCLUSIONS IN THE QUEEN CONCH (*LOBATUS GIGAS*)

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In St. Kitts, Lesser Antilles, queen conch (*Lobatus gigas*) invariably show large numbers of unusual, intracytoplasmic inclusions in epithelial cells of the digestive gland. Previous studies described these inclusions as apicomplexan parasites, and they are reportedly ubiquitous across the Caribbean region, and even suspected to cause mortality or reproductive failure. However, in our survey the digestive gland showed no features to indicate a response to injury, as would be expected with an infectious process. Furthermore, it is exceptionally rare for an infection to have 100% prevalence. Thus, we hypothesized that the inclusions were not infectious organisms. The aim of this study was to describe their composition using ultrastructural and molecular techniques. Histologically, the inclusions start as 2-4um, blue-purple to brown spherical granules and transition to 10x30um elongate ovoid to tri-bulbous dark brown inclusions. Some were found within the lumen of digestive gland ducts and the gastrointestinal tract. The brown pigment in the large inclusions stained with Fontanna Masson and was removed with melanin bleach. The rims of the large inclusions stained with Alcian blue (pH 2.5). The inclusions were also stained with Periodic Acid Schiff and Perls Iron stain. When examined with transmission electron microscopy, the inclusions consisted of electron-dense, variably compact lamellated deposits and were devoid of cellular organelles. DNA extractions of purified concretions did not yield sufficient concentrations for successful PCR amplification. When examined by scanning electron microscopy with energy dispersive x-ray analysis, the inclusions contained a number of elements, particularly iron. We conclude that these inclusions are not an infectious agent, and hypothesize that they are an iron storage-complex, potentially including other elements and a glycoprotein matrix. Similar structures have been described in the digestive glands of other invertebrates, including prosobranchs.

Keywords: pathology, conch, disease, histology, parasitology

MACROSCOPIC PATHOLOGY OF *ORBICELLA ANNULARIS* AND *O. FAVEOLATA* IN ST. KITTS

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The *Orbicella annularis* complex (*O. annularis*, *O. faveolata* and *O. franksi*) is an important framework group of corals on western Atlantic reefs. It comprises around 15% of all scleractinian corals in St. Kitts and Nevis. There are no detailed reports on the health status of the *O. annularis* complex around St. Kitts, particularly in shallow coastal areas where some of the largest colonies are found. The objective of this study was to systematically describe and categorize the macroscopic pathology and progression of lesions observed in *Orbicella* colonies in St. Kitts. We identified and tagged colonies of *O. annularis* (n=19) and *O. faveolata* (n=29) showing macroscopic lesions on 7 different shallow coastal reefs off St. Kitts. The lesions were categorized according to gross morphology including focal chronic tissue loss with marginal brown or yellow pigmentation, occasionally accompanied by a bleached band (n=36), focal brown pigmentation +/- intra-lesion foci of chronic tissue loss (n=18), focal to diffuse bleaching (n=13), and other (n=4). Tagged corals were monitored over a period of 31 weeks in the autumn/winter using GPS and laminated maps, and were photo-documented every 2 weeks. Tagged corals were monitored over a period of 31 weeks in the autumn/winter using GPS and laminated maps, and were photo-documented every 2 weeks. Based on initial observations, apart from the bleaching group, differences in lesion progression patterns were not evident among lesions groups. Some colonies exhibited tissue loss of up to approximately 1 centimetre per week and others remained visually stagnant or showed regeneration of affected tissue. Bleaching was first observed in October of 2016, when sea temperatures were higher than historical values. They started regaining their normal color by January 2017. Histopathology is presently underway with the aim to more comprehensively diagnose the diseases of St. Kitts' *O. annularis* and *O. faveolata*.

Keywords: pathology, *Orbicella annularis*, *O. faveolata*, macroscopic, disease

NUTRIENT ENRICHMENT SUPPRESSES AN INNATE IMMUNITY PATHWAY IN THE CORAL *PORITES PORITES* AND RECOVERY FROM PREDATION

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Reef-building corals face many threats from not only climate change, but also local stressors such as nutrient pollution. Recent studies show nutrient enrichment increases the negative effects of predation on coral reef communities by facilitating disease and reducing fitness in corals. This suggests the possibility that higher nutrient levels suppress the immune capabilities of corals as well as their capability to respond to microbial infections that follow mechanical injuries due to predation. In this study we measured the effect of nutrient enrichment and grazing on a well-recognized immune defense pathway, the phenoloxidase (PO) pathway involved in melanin synthesis and wound healing. *Porites porites* colonies were exposed in situ to either enriched nutrient levels using controlled release fertilizer containing nitrogen, phosphate, and potassium (19:6:12 of N:P:K) or ambient nutrient levels. Within these two treatments, corals were further exposed to either no damage, mechanical damage, or parrotfish grazing damage. Samples were taken: 1) prior to any damage; 2) after one week of recovery from an initial damage exposure; and 3) after one week of recovery from a repeated damage. The levels of two tyrosinase-type POs as well as one lactase-type PO were measured using enzymatic activity assays on a microplate reader. The two tyrosinase-type POs significantly decreased under nutrient enrichment, suggesting the corals became immuno-compromised under nutrient enrichment. Altogether, this study illustrates the need for the mitigation of nutrient pollution to coral reefs as higher nutrient levels might suppress coral immune capabilities, thereby increasing the susceptibility of corals to disease and subsequent mortality.

Keywords: Coral, nutrients, predation, phenoloxidase, immunity

DOES VARIABILITY IN WATER TEMPERATURE AND DISSOLVED OXYGEN INFLUENCE THE MOVEMENT PATTERNS OF TWO CARIBBEAN FISH?

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Movement plays an important role in an animal's behavior and life history demographics, and is a key component of ecological processes. Measuring and mapping movement patterns for highly mobile fish species may shed light on habitat space-use requirements, behavioral responses to environmental factors and population dynamics. Changes in ambient water conditions (e.g.. temperature, dissolved oxygen, etc.) can influence an individual's physiology and thus movement patterns. While some laboratory studies have examined the effects of environmental factors on fish physiology, few have examined how ambient water conditions affect fish movements in marine habitats. This study investigates the potential influence of water temperature and dissolved oxygen on the movement patterns of Atlantic tarpon (*Megalops atlanticus*) and lane snapper *(Lutjanus synagris*) in Brewer's Bay, St. Thomas, U.S. Virgin Islands. Fifteen fish of each species bearing acoustic transmitters were tracked in an acoustic array and proximal data loggers measured dissolved oxygen and temperature. I expect the movement patterns of lane snapper and tarpon to shift in response to large changes in water condition. Short-term preliminary data from Atlantic tarpon movement in Brewer's Bay suggests that tarpon moves out of its daily activity space when temperatures exceeds above average conditions. This study provides a better insight on which fish species are indicators for environmental variability and thus aiding fisheries managers in making accurate predictions on fish populations.

Keywords: movement, acoustic telemetry, *M.atlanticus, L.synagris*, environmental variability

INFLUENCE OF GLOBAL AND LOCAL STRESSORS ON THE CORAL REEFS NEAR HAVANA, CUBA

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Coral reefs are affected by both local and global stressors. While impact of local stressors such as eutrophication and overfishing have been increasing for at least the past century, intensifications and higher frequency of global stressors, particularly thermal stress events associated with global warming, are a more recent development. Understanding the temporal and spatial scale at which these factors affect coral reefs has serious implications for management and conservation strategies. Here, we combine current surveys and historical data from four coral reef zones located at different distances from long-term major sources of pollution and other anthropogenic activities Havana City, Cuba to investigate the potential importance of local versus global stressors on fish and benthic composition. In May 2016 we assessed nutrient content in algal tissue, depth of deposited sediment layer, benthic composition, fish community structure, and herbivore grazing activity. We found a ubiquitous and historically (since 1970s) high fishing pressure leading to the current low herbivorous fish biomass (12g/m2) across all sites regardless of the distance from Havana City. As a consequence of the poor herbivory pressure (<3bite/0.25m2/min), there was a very high relative abundance of macroalgae (67%) dominated by palatable species. Analysis of historical data (1995-2016) shows that coral cover closer to Havana has been low prior to 1995, probably as a consequence of high eutrophication levels and other local stressors. However, after the 1990s coral cover from Havana city's further and healthier reefs has decreased about 50%, possibly as a consequence of global stressors (e.g. higher frequency of intense bleaching events and Hurricanes). Our results suggest a possible transition from local to global factors shaping benthic communities began in the 1990's. While fish and benthic communities were initially (before 1990s) affected by localized stressors (e.g. eutrophication and overfishing), today overfishing continues to affect all areas while coral community has apparently transitioned to be more greatly affected by global stressors.

Factores locales como la eutroficación y la sobrepesca han estando afectando los arrecifes coralinos por mas de un siglo mientras que el efecto de los factores globales se ha visto mas acentuado en los últimos anos. Por tanto, para poder proponer medidas de manejo y recuperación de estos ecosistemas se hacen necesarios estudios que integren el efecto de estos factores a diferentes escalas temporales y espaciales. Nuestro estudio combina una serie de muestreos recientes y pasados de las comunidades arrecifales localizadas a diferentes distancias de una fuente significativa de contaminación y alta presión pesquera, la Ciudad de la Habana, Cuba, y su relación factores estresantes globales. Nuestros resultados muestran una fuerte presión de pesca a todo lo largo de la zona de estudio desde 1970's que explica la actual baja biomasa de peces herbívoros (12g/m2) y reducida presión de herbivory (<3 mordidas/0.25m2/min). Como consecuencia, la cobertura de macroalgas alcanza niveles muy altos (67%), principalmente de especies comúnmente

consumidas por peces herbívoros. El análisis histórico (1995-2016) de cobertura coralina revela que los arrecifes cerca de la Ciudad Habana han sido fuertemente afectados por factores locales como la eutrofización y sobrepesca desde antes del 1995 (<10%) y no han sufrido cambios desde entonces. Sin embargo, la cobertura de corales en los arrecifes mas alejados de la Ciudad, disminuyo mas de un 50% desde inicios del 2000, posiblemente como resultado del incremento en la frecuencia e intensidad de huracanes y eventos de blanqueamiento. Nuestros resultados indican una posible transición en el nivel de impacto de factores locales y globales. Inicialmente (antes de 1990's), factores como la sobrepesca y eutrofización fueron las principales amenazas de los arrecifes mientras que en la actualidad la combinación de ambos factores, locales y globales parecen estar afectando estos ecosistemas.

Keywords: Coral, Algae, Herbivory, overfishing, eutrophication, Cuba

EFFECTS OF FLORIDA RED TIDES ON HISTONE VARIANT EXPRESSION AND DNA METHYLATION IN THE EASTERN OYSTER *CRASSOSTREA VIRGINICA*

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Massive algal proliferations known as Harmful Algal Blooms (HABs) represent one of the most important threats to coastal areas. Among them, the so-called Florida Red Tides (FRTs, caused by blooms of the dinoflagellate *Karenia brevis* and associated brevetoxins) are particularly detrimental in the southeastern U.S., causing high mortality rates and annual losses in excess of $40 million. The ability of marine organisms to cope with environmental stressors (including those produced during HABs) is influenced by genetic and epigenetic mechanisms, the latter resulting in phenotypic changes caused by heritable modifications in gene expression, without involving changes in the genetic (DNA) sequence. Yet, studies examining cause-effect relationships between environmental stressors, specific epigenetic mechanisms and subsequent responses are still lacking. The present work contributes to increase this knowledge by investigating the effects of Florida Red Tides on two types of mechanisms participating in the epigenetic memory of Eastern oysters: histone variants and DNA methylation. For that purpose, a HAB simulation was conducted in laboratory conditions, exposing oysters to increasing concentrations of *K. brevis*. The obtained results revealed, for the first time, the existence of H2A.X, H2A.Z and macroH2A genes in this organism, encoding histone variants potentially involved in the maintenance of genome integrity during responses to the genotoxic effect of brevetoxins. Additionally, an increase in H2A.X phosphorylation (γH2A.X, a marker of DNA damage) and a decrease in global DNA methylation were observed as the HAB simulation progressed. Overall, the present work provides a basis to better understand how epigenetic mechanisms participate in responses to environmental stress in marine invertebrates, opening new avenues to incorporate environmental epigenetics approaches into management and conservation programs.

Keywords: Epigenetics, Harmful Algal Blooms, Brevetoxins, Oysters, Histone Variants, DNA Methylation

A CARIBBEAN WIDE DISEASE AFFECTING OCEAN SURGEONFISH (*ACANTHURUS BAHIANUS*)

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Disease outbreaks have led to mass mortality of many species resulting in changes that affected most Caribbean coral reef communities. In 2012, many individuals of the surgeon fish *Acanthurus bahianus* in Bonaire had black spots on their bodies and fins. To better understand this newly discovered disease and its implication for coral reefs, three analyses were conducted: a google picture search, in situ fish counts and fish dissections. The google search for pictures of *A. bahianus* discovered that the disease was present since 1985 and is found in many other Caribbean locations. Within the Caribbean, Bonaire was the location with the highest percentage of diseased *A. bahianus*,, making it the ideal location to study this disease. The in situ count of healthy and diseased *A. bahianus* determined that the number of healthy *A. bahianus* increased with depth. On the east side of Bonaire, less than 50% of the fish were diseased, while all sites on the west side of Bonaire had more than 50% diseased individuals. At the site located in front of the main town, Kralendijk, 81.6% of all fish were diseased. Dissections of diseased *A. bahianus* determined that the disease is caused by an encysted parasite, likely a Digenean trematoide (flatworm) in the metacercariae life stage. The parasite was found in the fins and skin tissue of the fish with some cysts damaging the cartilage of the fin ray. Furthermore, a smaller number of bacteria were found in diseased epidermis than in healthy epidermis. No other negative consequences were found, black spot disease will thus unlikely lead to mass mortality of *A. bahianus*. However, due to its visibility, it could possibly serve as a reef health indicator. Therefore, further research should be conducted to identify possible linkages between environmental factors such as pollution and the disease prevalence.

Keywords: Parasite, google picture search, fish counts, disease prevalence, spatial differences, health indicator

ISLAND HOPPING: CORAL REEF FISH PHYLOGEOGRAPHY ACROSS THE CARIBBEAN

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In the Caribbean, there was a long-standing paradigm of coral reef fish populations being open systems – a good deal of migrant exchange. This was supported by population genetic studies. However, in the past 10 years, this paradigm has shifted. It is now recognized that while some species of Caribbean coral reef fishes have little to no genetic structure among populations, some have substantial genetic subdivision throughout their ranges, and some have subtle, but present, population genetic structure. There is no longer a “one size fits all” rule for Caribbean coral reef fish population genetics. In this study, we tested for, and characterized population genetic structure in the Caribbean reef fish *Acanthemblemaria aspera*, the rough head blenny. Populations throughout the Caribbean, as well as the Yucatan were sampled. DNA sequence data was collected for mitochondrial and nuclear genes. These data were analyzed using new Bayesian methods that allow the inference of colonization history across a spherical plane. We used this to construct a model that inferred the place of the original population of *A. aspera* and the species’ dispersal pathways throughout the Caribbean Basin and Gulf of Mexico. In some scenarios, the original population, and the stepping stone populations, were inferred to be at locations where we had not yet collected samples. This has provided us with a framework to guide further collections and extend our work to other Caribbean reef fish species.

En el Caribe, existía el paradigma de que las poblaciones de peces en arrecifes de coral eran sistemas abiertos - una buena cantidad de intercambio de migrantes. Esto fue apoyado por estudios de genética de poblaciones. Sin embargo, en los últimos 10 años, este paradigma ha cambiado. Ahora se reconoce que, aunque algunas especies de peces de los arrecifes de coral del Caribe tienen poca o ninguna estructura genética entre las poblaciones, algunas tienen una subdivisión genética sustancial a lo largo de sus rangos y algunas tienen una estructura genética sutil pero presente. Ya no existe una regla de "talla única" para la genética de poblaciones de peces de arrecifes de coral del Caribe. En este estudio, hemos probado y caracterizado la estructura genética de la población de los peces de arrecife del Caribe *Acanthemblemaria aspera*, la cabeza áspera blenny. Se muestrearon poblaciones en todo el Caribe, así como en Yucatán. Se recogieron datos de secuencias de ADN para genes mitocondriales y nucleares. Estos datos se analizaron utilizando nuevos métodos bayesianos que permiten inferir la historia de colonización a través de un plano esférico. Utilizamos esto para construir un modelo que infería el lugar de la población original de *A. aspera* y las vías de dispersión de la especie en la cuenca del Caribe y el Golfo de México. En algunos escenarios, la población original, y las poblaciones de escalones, se infirió que estaban en lugares donde

aún no había recogido las muestras. Esto nos ha proporcionado un marco para guiar colecciones adicionales y extender nuestro trabajo a otras especies de peces caribeños del arrecife.

Keywords: phylogeography, coral reef fisheries

EXTENSIVE PHENOTYPIC VARIATION AMONG THE THREE CARIBBEAN ACROPORID CORALS

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The merging of two genomes through hybridization produces a unique combination of traits and phenotypic variation in the hybrids. This phenotypic variation may promote hybrid adaptation to habitats not accessible to the parent species. In the past, hybridization between Caribbean *Acropora palmata* and *A. cervicornis* corals was rare and restricted to the F1 generation. New genetic data indicates that hybrids are now mating with each other (F2) and are capable of mating with *A. palmata* and *A. cervicornis* (backcross). In parallel, a variety of intermediate morphologies to the arborescent staghorn and elkhorn shaped parental species are now observed. Here, we conducted morphometric analyses using high-resolution 3D scans and scanning electron microscopy on Caribbean acroporid colonies representing the continuum of phenotypes between *A. cervicornis* and *A. palmata* and correlated the data with the genetic origin of the hybrid (i.e., F1, F2 or backcross). Our results suggest that intermediate morphologies are not restricted to F1 hybrids, but a mixture of backcross and possibly F2 individuals. These data together with recent field observations of disease resistance and thermal tolerance, increased hybrid abundance, and hybrid habitat expansion suggests that the hybrids' ecological role and evolutionary potential is changing.

Keywords: hybridization, morphology, *A. prolifera*, adaptation

NOVEL PARASITES OF INVASIVE LIONFISH FROM ST KITTS AND THEIR POTENTIAL USE AS BIOLOGICAL TAGS

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Lionfish from the genus *Pterois* are native to the Indo-Pacific, but have been rapidly increasing in numbers in the western Atlantic and Caribbean Sea since they were accidentally released into the marine environment in the mid-1980s. They are now recognized as one of the most significant invasive species throughout the entire Caribbean region and their high numbers and feeding behavior are having a serious impact on coral reef biodiversity. Little has been documented about pathogens and parasites from these fish in their invasive Atlantic range, therefore, the aim of this study was to evaluate parasite load from fish that have been removed from the waters around St Kitts. Lionfish were speared by divers and taken directly to the laboratory for necropsy. All organs were examined for signs of gross pathology and fresh tissue preparations made to screen for the presence of microparasites using a compound microscope. Tissues that were observed to contain potential pathogens or parasites were prepared for histological examination and also preserved for DNA analysis, to assist in identification.
Two microparasites were observed that are currently being identified. Apicomplexan gammonts were observed in the urinary bladder, but no sporulated oocysts were present. Mature spores of a myxosporean were found in the gallbladder of some fish, which had a Zschokkella-like form. This data will be presented and discussed with respect to histopathological findings and initial microparasite identifications.

Keywords: Myxosporean, biological tag, lionfish.

THE EFFECTS OF NUTRIENT ADDITIONS ON THE GROWTH AND PHOTOSYNTHESIS OF PELAGIC *SARGASSUM* IN CARIBBEAN COASTAL AREAS BASED ON IN-SITU EXPERIMENTS

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Since 2011, the pelagic seaweed, *Sargassum* spp., has sporadically inundated the shores of the Caribbean and western Gulf of Mexico in unprecedented quantities. These events have not only lead to significant losses for the tourism and fisheries industries, but also damaged coastal ecosystems, such as the beaches and sea grass beds, by blocking light, depleting oxygen from coastal waters, and releasing hydrogen sulfide as it decomposes on beaches. Normally found in the nutrient-poor open ocean, we sought to determine how the growth of this seaweed changes as it nears coastal waters, subject to higher nutrient levels. We conducted 20-day in-situ growth experiments on two species of pelagic *Sargassum* found in the Caribbean, *S. fluitans* and a morphotype of *S. natans* that was previously thought to be *S. fluitans*, in order to determine the physiological differences between these species. We determined the effects of nutrient additions on growth rate and photosynthesis and found that *S. natans* grew significantly faster than *S. fluitans* in both treatments, with an average percent growth rate of 99% compared to 66%. This information is important in understanding the capacity of different species of pelagic *Sargassum* to alter coastal areas, since species have been found to host unique mobile fauna communities and may have different ecological impacts. With continued sporadic arrivals of *Sargassum* along the Caribbean coast, the information provided by this study offers more clues to help determine the nature and effects of these events.

Keywords: *Sargassum*, nutrients, growth rate, photosynthesis, Caribbean

FISH ASSEMBLAGES ON OUTPLANTED *ACROPORA CERVICORNIS* REEFS AND NATURAL REEFS IN SOUTHEAST, FLORIDA, USA

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The staghorn coral (*Acropora cervicornis*) has historically been a major contributor to reef structural complexity providing habitat for many fish and invertebrate species throughout Florida and the Caribbean. Unfortunately, due to impacts from disease, bleaching, and anthropogenic stressors, *A. cervicornis* populations have suffered drastic declines over the past several decades. In an attempt to preserve biodiversity, many organizations have turned to growing *A. cervicornis* in nurseries and outplanting them back onto the reef. This practice has been shown to be an effective method for increasing *A. cervicornis* abundance, however the effects on the local fish assemblage have not been thoroughly assessed. This gap is addressed by comparing fish populations on natural reefs to that of outplanted *A. cervicornis* reefs in southeast, Florida. Using the Reef Visual Census (RVC) method, surveys were conducted to record fish species and size at four locations biannually from 2012 to 2016. All four sites contained two control (natural) and three outplanted *A. cervicornis* reef arrays. Each reef array covered an area of approximately 80m2. A combined total of 40,259 fish and 136 species were counted on both reef types. Preliminary results show significantly higher fish density on natural reef, as well as significantly greater species richness. Labridae was the most abundant family on outplant reefs, and Haemulidae was the most abundant family on natural reefs. There was however, a non-significant increase in fish density at outplant sites over the course of the study as outplanted colonies increased in size. This suggests that outplanted reefs are not attracting the same fish as natural reefs, but fish density may continue to increase as *A. cervicornis* colonies grow.

Keywords: *Acropora cervicornis*, outplant, fish, natural

EFFECTS OF FLORIDA RED TIDES ON HISTONE VARIANT EXPRESSION AND DNA METHYLATION IN THE EASTERN OYSTER *CRASSOSTREA VIRGINICA*

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Massive algal proliferations known as Harmful Algal Blooms (HABs) represent one of the most important threats to coastal areas. Among them, the so-called Florida Red Tides (FRTs, caused by blooms of the dinoflagellate *Karenia brevis* and associated brevetoxins) are particularly detrimental in the southeastern U.S., causing high mortality rates and annual losses in excess of $40 million. The ability of marine organisms to cope with environmental stressors (including those produced during HABs) is influenced by genetic and epigenetic mechanisms, the latter resulting in phenotypic changes caused by heritable modifications in gene expression, without involving changes in the genetic (DNA) sequence. Yet, studies examining cause-effect relationships between environmental stressors, specific epigenetic mechanisms and subsequent responses are still lacking. The present work contributes to increase this knowledge by investigating the effects of Florida Red Tides on two types of mechanisms participating in the epigenetic memory of Eastern oysters: histone variants and DNA methylation. For that purpose, a HAB simulation was conducted in laboratory conditions, exposing oysters to increasing concentrations of *K. brevis*. The obtained results revealed, for the first time, the existence of H2A.X, H2A.Z and macroH2A genes in this organism, encoding histone variants potentially involved in the maintenance of genome integrity during responses to the genotoxic effect of brevetoxins. Additionally, an increase in H2A.X phosphorylation (γH2A.X, a marker of DNA damage) and a decrease in global DNA methylation were observed as the HAB simulation progressed. Overall, the present work provides a basis to better understand how epigenetic mechanisms participate in responses to environmental stress in marine invertebrates, opening new avenues to incorporate environmental epigenetics approaches into management and conservation programs.

Keywords: Epigenetics, Harmful Algal Blooms, Brevetoxins, Oysters, Histone Variants, DNA Methylation

CONNECTIVITY OF POPULATIONS AND GENE FLOW IN TOBAGO'S QUEEN CONCH *LOBATUS GIGAS* (LINNAEUS, 1758) POPULATION

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Tobago's queen conch fishery has seen a continued decline in productivity since the 1970s due to a lack of proper monitoring and management. With unregulated and unmonitored harvesting, Trinidad and Tobago remains unable to report on the status of the queen conch fishery, lending to the continuation of poor management.
Focusing on juvenile stages, the dispersal of local conch resources at larval stages via current flow can also be a key factor in its depletion, taking into consideration the magnitude of currents found in and around the Tobago coastal region. As such, it is necessary to determine the population's genetic structure, and to further identify whether there is indeed the potential for larval transport of Tobago's conch stock via existing current patterns. This study provides an improved understanding of connectivity of queen conch populations throughout the Caribbean, specifically in relation to population structures of queen conch in Tobago and their gene flow. It examines the potential for larval transport with the goal of testing the null hypothesis that geographically separated *Lobatus gigas* populations are genetically linked, by analysing gene flow as a means of differentiating the conch populations. Very little research has been done regarding Trinidad and Tobago's conch population, so this study will serve as a first look into the genetic population structures, and possibly give new insight into better approaches that facilitate more effective management of the resource. It also constitutes a first step in understanding the queen conch metapopulation structure, which will in turn, call for more local actions for the recovery and conservation of Tobago's populations.

Keywords: *Lobatus gigas*, queen conch, connectivity, gene flow, Tobago

VARIABILITY IN CORAL AND OCTOCORAL RECRUITMENT ALONG THE FLORIDA REEF TRACT

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There is consensus that recruitment failure is impeding coral recovery along the Florida Reef Tract (FRT), but how this parameter varies at the reef scale and through time is unknown. To fill this knowledge gap we are quantifying scleractinian and octocoral recruitment at 30 long-term monitoring sites across the FRT that are part of the Coral Reef Evaluation and Monitoring Project. At each site, 32 pairs of grooved terracotta settlement tiles (15 x 15cm) were attached to the substrate and retrieved after one year (n = 1,920 total tiles). There was high variability in recruitment among regions (i.e., SE Florida, upper, middle, and lower Keys) and even among sites within a region. There is a latitudinal shift in recruit position from upper to lower surfaces progressing from north to south along the FRT. Brooding scleractinians (with the exception of *Siderastrea siderea*) were most common and octocoral recruitment more localized. This study is informing reef management efforts of the regional differences in coral recruitment within the FRT suggesting that multiple management plans may need to be employed.

Keywords: coral, recruitment, resilience, settlement, octocoral

MANAGERIAL IMPLICATIONS OF PERCEPTIONS, KNOWLEDGE, ATTITUDES AND AWARENESS OF RESIDENTS REGARDINF PUERTO MORELOS REEF NATIONAL PARK, MEXICO

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This study explores the perceptions of local residents of Puerto Morelos, Quintana Roo, Mexico, concerning Puerto Morelos Reef National Park using semi-structured and key informant surveys. Collectively, the data provides qualitative and quantitative information regarding attitudes, knowledge, and awareness of park regulations and natural resources, as well as opinions about the formation and management of the protected area. The results show large differences in knowledge and awareness based on location of households within the community. Demographic indicators including education level, nationality, and length of community residence significantly correlate with perceptions about marine protection. There was a significant relationship between awareness of economic growth provided by the protected area and the level of support for protection, but many residents–particularly newer residents, those living farther inland, and those of lower educational levels—were unaware of the park, its resources, or its management. Further understanding of the relationships between social indicators and resource management is needed for conservation of important coastal resources. The results suggest that much more public outreach and education are needed within the region.

Keywords: Puerto Morelos Reef National Park, Marine Protected Areas, Human Dimensions

HISTOPATHOLOGICAL INVESTIGATION OF EMBRYONAL MORTALITY IN LEATHERBACK SEA TURTLES (*DERMOCHELYS CORIACEA*) IN ST. KITTS

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Critically endangered leatherback sea turtles (*Dermochelys coriacea*) have a low global hatch success of 50%, hence, protection of eggs and successful hatching are critical for population recovery. In St. Kitts, hatch success typically averages from 5-10%, much lower than the global and regional average, and too low to maintain the population in the decades to come. The aim of our research is to determine the causes of embryonal death in leatherback sea turtles. A histopathological survey of non-emergent late stage embryos and hatchlings was undertaken in 2015-16 on St. Kitts two main nesting beaches. In 2015, 3 hatchlings and 21 embryos were examined from 10 nests. In 2016, 6 hatchlings and 54 embryos were examined from 5 nests. Postmortem examinations were performed on the turtles. The only macroscopic abnormality identified was miliary white nodular foci in the lungs of 5 turtles. Histologically, this change corresponded to bronchopneumonia (12.5% prevalence) observed in 5 nests, representing both nesting beaches and seasons. In all cases the bronchopneumonia was associated with gram-negative rods-shaped bacteria. Aerobic and anaerobic cultures failed to identify a predominant isolate, however Pseudomonas sp. was found in a number of nests in 2016. Hematopoiesis was consistently observed in the liver, lung, kidneys, spleen, and pericardium, and is likely a normal event in the late development of *D. coriacea*. Other lesions included muscle necrosis (11% prevalence) and renal tubular mineralization (25% prevalence). Bacterial pneumonia appears to be a significant cause of death in St. Kitt's leatherback embryos and hatchlings. Further investigation is warranted to determine the causes of the lesions identified in this study, and their impact on hatch success in the wider Caribbean.

Keywords: Leatherback, Sea Turtle, Embryology, Histology, Pathology, Conservation

STONY CORAL MORTALITY ASSOCIATED WITH THE DISEASE OUTBREAK ALONG THE SOUTHEAST FLORIDA REEF TRACT

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The northern extent of the Florida Reef Tract, offshore Southeast Florida (USA) is formed by a series of linear reef structures along a highly developed coastline. The Southeast Florida Coral Reef Evaluation and Monitoring Project (SECREMP) has monitored reef conditions in this region via annual image analysis and transect data since 2003 with the addition of stony coral, gorgonian and barrel sponge demographic data in 2012. The project currently monitors 22 permanent sites distributed along the Florida Reef Tract from Martin County to Miami-Dade County. Starting in late 2014, increased disease prevalence, much appearing to be white-plague type, and disease related mortality were reported throughout the region. By summer 2016, significant region-wide declines in *Dichocoenia stokesii*, *Meandrina meandrites*, and *Montastraea cavernosa* densities were recorded. Significant *M. cavernosa* loss, one of the major contributors to regional stony coral cover, is of particular concern. *M. cavernosa* has historically been considered one of the hardiest species that commonly has large colonies on the reef. With disease observations continually reported for more than two years, it appears that the northern portion of the Florida Reef Tract is experiencing the greatest multi-species stony coral mortality event in recent times.

Keywords: Coral Disease, Southeast Florida, Coral Mortality, Disease Event

STUDY OF DISCRETE MORPHOMETRIC CHARACTERISTICS OF SAGITTAE OTOLITH OF LIONFISH (*PTEROIS VOLITANS*) IN PUERTO MORELOS

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The lionfish Pterois volitans, is the first species of non-native marine fish to settle along the western Atlantic coast of the USA, Caribbean Sea, and Gulf of Mexico, in part because of the wide-ranging environmental tolerances. This has added more concerns to the managers of the region's marine resources. Several authors have provided evidence that fish otolith shapes are species-specific, it is widely accepted that shape of sagittae otolith analysis can be used for age, population and species identification studies, and can provide necessary and relevant information for ecological studies. The study of shape properties is an important topic in pattern recognition and digital images processing, where the information is in the discrete domain, for this reason the implementation of discrete morphometric descriptors is necessary to obtain otolith shape characteristics from digital images, for this reason the purpose of this study was to analyze and quantify shape disparities of lionfish sagittae otoliths by the discrete morphometric measurements, for example tortuosity, compactness, and Euler number in the discrete domain. The left and right sagittae from 104 specimens of P. volitans were analyzed. All specimens were caught by fisher cooperative of Puerto Morelos, Quintana Roo, Mexico. All digital images were acquired by a Nikon DS-Ri1 camera coupled to a Nikon LMZ15000 optic microscope. In this case of the Mexican Caribbean, the morphological analysis did not show a particular pattern to classify the lionfish by classic descriptors. Thus, it was necessary to implement morphometric descriptors in the discrete domain that may help to characterize the otolith shape of the Caribbean lionfish. This study presents results of these discrete descriptors, on the similarity or dissimilarity between the left and right sagittae of P. volitans, and to asses and quantify the shape changes through the ontogeny of lionfish.

El pez león, *Pterois volitans*, es de las primeras especies marinas no nativas que se han establecido a lo largo de la costa atlántica occidental de los Estados Unidos de América, el mar Caribe y el Golfo de México, en parte debido a que tiene amplias tolerancias ambientales. El establecimiento del pez león a lo largo de estas áreas marinas ha aumentado las preocupaciones que enfrentan los administradores de los recursos marinos de la región.
Varios autores han aportado pruebas de que la forma de los otolitos en peces es específica de cada especie. El análisis de la forma del otolito sagitario puede utilizarse para estudios de edad, identificación de especies y stocks pesqueros o poblaciones, y puede proporcionar información necesaria y relevante para estudios ecológicos. El estudio de las propiedades de la forma es un tema importante en el reconocimiento de patrones y procesamiento de imágenes digitales, donde la información está en un dominio discreto, por esta razón la implementación de descriptores morfométricos discretos es necesaria para la extracción de características de forma a partir de imágenes digitales. El propósito de este estudio fue analizar y cuantificar las variaciones de forma de los otolitos sagita del pez león a partir de mediciones morfométricas discretas como por ejemplo la tortuosidad, la compacidad y el número de Euler en el dominio discreto. Se analizaron los otolitos sagita izquierdo y derecho de 104 ejemplares de *P. volitans*. Todas las especies fueron capturadas por la cooperativa pesquera de Puerto Morelos, Quintana Roo, México. La adquisición de imágenes digitales de

otolitos fue realizada por una cámara Nikon DS-Ri1 acoplada a un microscopio óptico Nikon LMZ15000. En este caso del pez león del Caribe mexicano, el análisis morfológico no mostró un patrón morfológico particular que nos ayude a clasificar esta especie a partir de descriptores morfométricos clásicos, por lo que fue necesario implementar descriptores morfométricos en el dominio discreto que nos ayudaran a caracterizar la forma del pez león. Este estudio presenta resultados de estos descriptores discretos sobre la similitud o disimilitud entre los otolitos sagita izquierdos y derechos de *P. volitans,* para corroborar y cuantificar los cambios en la forma de los otolitos a través de la ontogenia del pez león.

Keywords: Discrete morphometry, Lion fish, Puerto Morelos, Pattern recognition

DISEASE RESISTANCE IN THE THREATENED STAGHORN CORAL, *ACROPORA CERVICORNIS*

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The staghorn coral, *Acropora cervicornis*, is a major reef-building scleractinian coral found throughout Florida and the Caribbean that experienced dramatic population declines starting in the late1970s. The declines are attributed primarily to white-band disease (WBD and coral bleaching, and other tissue loss syndromes. Previous research in Panama indicates that disease-resistant genotypes exist. It is unknown if disease resistant genotypes exist in Florida Keys populations. We tested the potential for rapid tissue loss (RTL) resistance among 48 *A. cervicornis* genotypes maintained in a Florida Keys nursery by grafting active disease fragments to apparently healthy fragments. Tissue degradation was documented visually by the presence or absence of RTL (denoted by a characteristic margin where the zooxanthellate tissue is denuded from the skeleton), followed by histological analysis to further characterize potential tissue degradation. In this preliminary disease screening, 41 out of 48 genotypes did not show signs of rapid tissue loss transmission after five days. Only two control fragments showed signs of disease transmission. Continued histological analysis and a highly replicated disease transmission study in 2017 will help confirm disease resistance. These results will help inform and potentially increase the efficacy of future management strategies of *Acropora* populations.

El coral cuerno de ciervo, *Acropora cervicornis*, es uno de los mayores constructores de arrecifes de coral desde Florida hasta el Mar Caribe. Este coral escleractinio ha experimentado dramáticos descensos en sus poblaciones desde 1970. Las pérdidas de esta especie se han atribuido al blanqueamiento de coral, a la enfermedad de la banda blanca y a otros síndromes de pérdida de tejido. Investigaciones anteriores han indicaron que genotipos resistentes a dichas enfermedades existen en Panamá, sin embargo, hasta el momento no existe información de los genotipos resistentes en las poblaciones de los Cayos de la Florida. El presente estudio analizó la resistencia a la pérdida de tejido en 48 genotipos de A. cervicornis de una guardería de los Cayos de la Florida, mediante el injerto de fragmentos con enfermedad activa en fragmentos aparentemente sanos. La degradación de tejido fue documentada mediante análisis visual de presencia o ausencia de pérdida de tejido (exhibida por el margen característico en donde se presenta el tejido de la zooxantela separado del esqueleto coralino desnudo), así como el análisis histológico para caracterizar la degradación potencial de los tejidos. En el análisis preliminar, 41 de 48 genotipos no mostraron signos de transmisión del síndrome de pérdida de tejido después de cinco días de exposición. Los análisis histológicos posteriores y las réplicas del estudio de transmisión en 2017, ayudarán a confirmar la resistencia de los genotipos. Estos estudios en conjunto contribuirán a informar e incrementar la eficacia de las estrategias de manejo de las poblaciones de *Acropora* en el futuro.

Keywords: Coral, Disease, Acropora, Histology, Restoration

RECENT INFLUX OF PELAGIC *SARGASSUM* ONTO THE CUBAN COASTLINE

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In 2011, pelagic *Sargassum* in very large masses, was observed for the first time in the Tropical North Atlantic from Africa to the NE coast of South America and the eastern Caribbean. At first it was thought to arrive by spreading southward from the Sargasso Sea. But efforts at determining its origin suggested that it most likely was 'seeded' into the tropics and bloomed under favorable conditions. Satellite imagery shows that it is increasing over time and not a temporary condition. The *Sargassum* events has significantly impacted marine fisheries, shorelines, embayments and reefs of nations from the Lesser Antilles to NW Brazil and West Africa. In more recent years it has created major impacts within the Caribbean. In late October 2016, pelagic *Sargassum* in unusually large quantities was observed floating just offshore along the Malecón in Havana, Cuba. At the same time, mats and lines were washing ashore along Cayo Cocos, Cuba in such quantities as to require clean-up activities on the resort beaches. This ~450 Km stretch of coast has previously received pelagic Sargassum along its shoreline, but never has such a large and extensive event been recorded. It was thought that the small amounts previously received were coming from the Sargasso Sea through the Old Bahamas Channel or into the Caribbean via the Mona Passage. Using archived surface current data from a numerical ocean current model (HYcom), the *Sargassum* in this event was back tracked from observed landings in Havana and Cayo Cocos through the Caribbean and into the Tropical region of the Atlantic, passing through the Lesser Antilles in the previous July of 2016 as confirmed by satellite. Although the event in Cuba was relatively light compared to elsewhere in the Caribbean and the Tropical Atlantic, it does demonstrate that preparations for its influx should be made.

Keywords: pelagic *Sargassum*, currents, bloom, Caribbean, Tropical Atlantic

CONSECUTIVE WINTER BLEACHING EVENTS OBSERVED ON DEEPER REEF SITES NEAR CARRIE BOW CAY, BELIZE

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Ongoing reef monitoring efforts included bi-annual surveys at 24 permanent transects in the vicinity of Carrie Bow Cay, Belize. Starting in 2011, a comprehensive protocol assessed the abundance, species diversity, size distribution and condition of scleractinian corals and fishes on transects spanning four depth habitats from 5m-20m. Surveys from 2015-2017 recorded significant bleaching events persisting well into the winter months of December 2015 and January 2017. The number of colonies and species affected was positively correlated with depth. The greatest impact was observed at 20m. In 2015, bleaching recorded in December was largely sublethal, with less than 5% of bleaching colonies experiencing tissue mortality. However a second bleaching event, beginning in October 2016 and persisting into January 2017 produced significant amounts of coral mortality. Possible drivers including patterns of temperature, salinity, turbidity are explored.

Keywords: Coral Bleaching, Reef Monitoring

DETERMINATION OF THE DEGRADATION RATE OF LIONFISH EDNA IN THE LABORATORY

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Detection of the invasive lionfish in highly complex tropical ecosystems will require more than visual surveys and population control efforts will be more successful if lionfish removal is focused on areas known to have lionfish. Lionfish hunting is an effective strategy for controlling the lionfish population within recreational diving limits; especially on oceanic islands with fringing reefs. Mangrove habitats are difficult ecosystems for lionfish hunting and new methods are needed to detect lionfish. Mangroves are important areas for juvenile reef fish and some species require mangroves in the juvenile stages. In freshwater ecosystems, environmental DNA (eDNA) techniques have become widely used due to their success in detecting target species, and recently eDNA techniques started being utilized in marine ecosystems. An important component for determining lionfish density in mangroves will be to determine the degradation rate of lionfish eDNA in the laboratory. To determine the average degradation time of lionfish eDNA, water samples from aquariums that held one lionfish for 24 h were sampled over nine days. Water was filtered to extract DNA from seawater samples. DNA was amplified, and gels were run using electrophoresis. The degradation rates determined using this technique will be used in parallel with another study in our laboratory to detect lionfish DNA on coral reefs where the exact location of the lionfish is known. This study will result in the ability to estimate the presence on lionfish within an important parameter; the rate of degradation and that will contribute to developing the technique required to determine locations of lionfish for removal.

Keywords: Lionfish, environmental DNA, eDNA, degradation

ADAPTATION AND RESILIENCE IN A CHANGING CLIMATE: CRYPTIC *SYMBIODINIUM* SP. IN FLORIDA'S PILLAR CORAL OFFER A GLIMMER OF HOPE

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Like many coral reefs worldwide, the Florida Reef Tract (FRT) experienced two consecutive hyperthermal bleaching events during the summers of 2014 and 2015. The iconic and unique pillar coral, *Dendrogyra cylindrus*, suffered severe bleaching throughout the 320 km FRT. While all D. cylindrus colonies bleached severely during summer 2014, one Upper Keys site appeared more resistance to bleaching during the 2015 event and returned to normal coloration more quickly than some sites in the Middle and Lower Keys. This pattern of resistance was linked to a shift of the dominant Symbiodinium species associated with *D. cylindrus*. Following the first bleaching event in September 2014, we observed a rapid change in dominance from the typically hosted *Symbiodinium* 'dendrogyrum' to the cryptic S. 'meandrinium', where the dominance of this latter persisted throughout the second bleaching event in August/September 2015 and through April 2016. The fine taxonomic resolution achieved in this study through the use high-throughput amplicon sequencing of the chloroplast 23S hypervariable region allowed the discovery of an ecologically relevant shift and a glimmer of hope for adaptation and resilience for corals in a changing climate.

Keywords: adaptation, *Dendrogyra cylindrus*, Florida Reef Tract, hyperthermal bleaching, pillar coral, resilience

CARBON SOURCES SUPPORTING FOOD CHAINS IN A MANGROVE FOREST AND ADJACENT INTERTIDAL MUDFLATS: A STABLE ISOTOPE TECHNIQUE FOR ASSESSING ECOSYSTEM CONNECTIVITY

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The abundance of food resources has been promoted as one of the principal attributes of mangroves and mudflats as nursery habitats for juvenile fish. Identifying the primary producers sustaining these food webs is the foundation for informed management plans to conserve biodiversity and commercial resources in a habitat mosaic. These habitats are also thought to be interlinked through diurnal or tidal fish migrations and carbon exchange. We use carbon and nitrogen stable isotope analysis (SIA) of primary producers, benthic and planktonic meiofauna, invertebrates, fishes and birds to identify the autotrophs underpinning food webs in a mangrove forest and adjacent intertidal mudflat in the Gulf of Paria, Trinidad and Tobago. We find isotopically distinct food webs in the two habitats, and even isotopic distinctions for the same species collected in both habitats. MixSIAR mixing models show that mangrove carbon does not support fish populations in an adjacent mudflat ecosystem and may only partially support fishes in mangroves along with other carbon sources. This reaffirms findings from previous studies that question the role of mangrove carbon in food webs and the 'outwelling' hypothesis. In both habitats, phytoplankton and/or benthic microalgae support foodwebs for fishes and waterfowl. We observed little evidence of connectivity between the two habitats in terms of carbon exchange and feeding migrations for several planktivorous and demersal fish species. We present the possible reasons for this habitat isolation and what it means for management of fish nursery habitats.

Keywords: mangrove, mudflat, fish, nursery, isotopes, food webs

IMPACT OF WATER TEMPERATURE INCREASE IN THE PHOTOSYNTHESIS AND CALCIFICATION/GROWTH RATE OF THREE LIFE STAGES OF *PORITES ASTREOIDES*

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A rise in sea surface temperature can affect corals physiological processes in different ways during each development stage. Here, we determine the impact of temperature increase on symbiont photosynthesis and growth/calcification of coral host in *Porites astreoides* at different developmental stages which include swimming larvae, newly settled juveniles and adults. Photosynthetic efficiency (Fv/Fm') of symbionts in adults and larvae were measured using a Diving PAM (Walz). Calcification rates of adults were measured using the buoyant weight technique, and the growth rates of the swimming larvae and newly settled juveniles were measured using light microscopy and Image J-Fiji software. The temperature treatments include 28°C, an intermediate mildly stressful temperature of 30°C, and a third treatments of 32°C which is the threshold for bleaching, Photosynthetic efficiency of the swimming larvae was not affected by temperature increase, meanwhile, newly settled juveniles exhibited more variation in Fv/Fm values. The adult stages showed a dramatic decrease in photosynthetic efficiency. No significant changes with increase in temperature were observed in growth rates for the swimming larvae and newly settled juveniles. However, the calcification rate of the adults slightly increased at higher temperature. Thus, the susceptibility to thermal stress varies depending on the life stage.

Keywords: *Porites astreoides*, temperature increase, photosynthesis, calcification, life stages

GRAZING BY GREEN TURTLES INDUCED A COMMUNITY SHIFT FROM CLIMAX TO EARLY SUCCESSIONAL SPECIES IN THE CARIBBEAN.

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In the Caribbean, Green turtles (*Chelonya mydas*) practice rotational grazing where *Thalassia testudinum* grazing patches are used for up to 2 years, after which these patches are abandoned. This study examined the effects of simulating grazing (clipping) by green turtles on both ungrazed and grazed abandoned seagrass patches during different periods. Treatments included 0 (control, no grazing), 4, and 8 months of simulating clipping, and treatments for grazed abandoned patches were 8 months of clipping and 8 months of recovery without clipping. Grazing resulted in a decrease in shoot density and below ground biomass for the preferred turtle food *T. testudinum*, while an increase in these parameters was observed for the faster growing seagrass *Syringodium filiforme*. By contrast, *T. testudinum* leaf length, leaf width, foliar shoot density, and biomass were negatively affected by the simulated grazing. As grazing time increased, *T. testudinum* leaf C/N-ratios decreased and ammonium pore water levels increased, suggesting a reduced demand for nitrogen by *T. testudinum*. Patches with 8 months of clipping after abandonment showed rhizome soluble carbohydrate content and leaf tannin concentration greatly reduced, suggesting a total depletion of energetic and carbon reserves. This latter was confirmed by an increase in carbohydrate reserves in *T. testudinum* from the abandoned patches that had recovered for 8 months. This time series showed that grazing on *T. testudinum* cause carbon depletion and increase the ammonia in the sediments. Ammonia is a resource available for the fast growing *S. filiforme*, causing a community shift from *T. testudinum* into *S. filiforme*.

En el Caribe la tortuga verde (*Chelonya mydas*) practica pastoreo rotacional en pastizales marinos dominados por *Thalassia testudinum*, manteniendo parcelas ramoneadas hasta por dos años que posteriormente son abandonadas. Este estudio analizó el efecto de la herbivoría por tortugas utilizando parcelas sin pastoreo y parcelas abandonadas de manera natural. Los tratamientos consistieron en diferentes niveles de intensidad de herbivoría (tiempo). En parcelas sin pastoreo previo se estableció el control (nivel 0), y dos niveles adicionales simulando el pastoreo de tortugas (clipping) durante 4 y 8 meses respectivamente. En parcelas abandonadas, se estableció un tratamiento con herbivoría artificial por 8 meses y uno más con 8 meses de recuperación (no herbivoría simulada). El pastoreo resultó en una disminución en la densidad de haces y biomasa subterránea para la especie preferida por las tortugas *T. testudinum*. Los mismos parámetros incrementaron para la especie de crecimiento rápido *Syringodium filiforme*. Al aumentar el tiempo de pastoreo, disminuyó la longitud, ancho y proporción de C/N en hojas de *T. testudinum*. En cambio la concentración de amonio incrementó en el agua intersticial del sedimento, que sugiere una disminución en la demanda de nitrógeno por *T. testudinum*. Las parcelas abandonadas y con pastoreo artificial por 8 meses, mostraron las menores

concentraciones de carbohidratos solubles en los rizomas y de contenido de taninos en hojas, como una posible causa de la reducción en sus reservas energéticas y de carbono. Esto concuerda con el aumento de carbohidratos solubles de *T. testudinum* en las parcelas abandonadas naturalmente pero con 8 meses de recuperación. Se sugiere que una pérdida en las reservas de carbohidratos solubles en los rizomas de *T. testudinum* y el aumento de amonio disponible en el sedimento, favorecen un cambio en la comunidad de pastos marinos hacia una mayor abundancia de especies de crecimiento rápido como *S. filiforme*.

Keywords*:* *Chelonya mydas,* seagrass, grazing, clipping, *Thalassia testudinum, Syringodium filiforme*

MARINE PROTECTED AREAS AND CORAL REEF RESILIENCY, CAYMAN ISLANDS

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Coral reefs in the Caribbean region have experienced widespread coral cover loss over the past 3 decades, primarily due to hurricanes, coral disease outbreaks, loss of "keystone" herbivores, coral bleaching, eutrophication and overfishing. Centrally located in the NW Caribbean, the Cayman Islands established a system of Marine protected areas in 1986. The current study aims to assess the benthic community composition at 40 sites around Grand Cayman, Little Cayman and Cayman Brac, for the years 2009, 2012, 2015 and 2016. Benthic community was analyzed and compared between MPAs and non-MPA areas across islands on their shallow and deep reef terrace reefs. Results revealed a low hard coral cover average across islands in 2009 of 9.5% and Macro-algae showing 79.44% cover to a much high coral cover average in 2016 of 21.7%, and a much lower macro algae cover of 42.2%. The remaining % benthic cover was composed of soft corals, crustose coralline algae, sand, rubble and dead corals. Comparisons between the three islands showed that the less developed Sister Islands had a higher coral cover compared to the more developed Grand Cayman. Additionally, the macro algal cover was higher in Grand Cayman and Cayman Brac. The two most abundant coral species within the waters of the Cayman Islands comprised the encrusting corals *Agaricia* and *Porites* spp. The high percentage cover of macro algae cover, which predominantly composed of *Dictyot*a and *Lobophora*. Analysis showed a higher species abundance along the southern coastlines and within the shallower reef systems. A temporal analysis demonstrated a significant increase in the cover of hard coral species across all the islands, with a net decrease in the macro algae cover. Following several bleaching and hurricane events during recent years, the Cayman Islands showed positive signs of recovery and suggest the presence of resilient reefs, especially within the MPAs.

Los arrecifes de coral en la región del Caribe han experimentado pérdidas generalizadas de cubierta coralina durante las últimas 3 décadas, principalmente debido a huracanes, brotes de enfermedades de coral, pérdida de herbívoros "clave", blanqueamiento de corales, eutrofización y sobrepesca. El presente estudio tiene como objetivo evaluar la composición de la comunidad bentónica en 40 sitios alrededor de Grand Caiman, Little Caiman y Caiman Brac, para los años 2009, 2012, 2015 y 2016. La comunidad bentónica fue analizada y comparada entre áreas protegidas marinas y áreas no protegidas a través de islas en sus arrecifes de arrecifes superficiales y profundos. Los resultados revelaron un promedio de cobertura de coral duro bajo en las islas en 2009 de 9.5% y Macroalgas mostrando un 79.44% cubriendo un promedio de cubierta de coral muy alto en 2016 de 21.7% y una cobertura de macro algas mucho más baja de 42.2%. El resto de la cubierta bentónica estaba compuesta por corales blandos, algas coralinas crustosas, arena, escombros y corales muertos. Las comparaciones entre las tres islas mostraron que las islas hermanas menos desarrolladas tenían una cubierta de coral más alta en comparación

con el Grand Caiman más desarrollado. Además, la cobertura macro algas fue mayor en Gran Caimán y Caiman Brac. Las dos especies de coral más abundantes dentro de las aguas de las Islas Caimán comprendían los incrustantes corales *Agaricia* y *Porites* spp. El alto porcentaje de cobertura de algas macro cubiertas, que se compone principalmente de *Dictyota* y *Lobophora*. El análisis mostró una mayor abundancia de especies a lo largo de las costas del sur y dentro de los sistemas de arrecifes menos profundos. Un análisis temporal demostró un aumento significativo en la cubierta de especies de corales duros en todas las islas, con una disminución neta en la cobertura de macroalgas. Después de varios episodios de blanqueo y huracán durante los últimos años, las Islas Caimán mostraron signos positivos de recuperación y sugieren la presencia de arrecifes resistentes, especialmente dentro de las MPAs.

Keywords: Marine protected areas, Cayman Islands, Coral reef resilience

CORAL BLEACHING IN THE MESOAMERICAN REGION (2015-2016)

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The Mesoamerican Reef extends for over 100km across the Caribbean coasts of Mexico, Belize, Guatemala and Honduras. It has experienced at least six bleaching events since the first recorded in 1995, including the 2015/2016 third global mass bleaching event, currently affecting reefs worldwide. In order to assess the extent of coral bleaching and its potential impacts in the Mesoamerican region (MAR), the Healthy Reefs Initiative led a regional Coral Bleaching Emergency Response Plan in partnership with 19 regional organizations. Surveyors quickly mobilized across the MAR region to monitor over 100 sites in October/November 2015 and again in 2016 assessing a total of 33,890 corals. Overall, the Mesoamerican Reef was moderately affected by this bleaching event, with 36% of corals “affected” in 2015 and 49% affected in 2016. Both years approximately half of the colonies were pale and half were either partly of fully bleached. The number of fully bleached corals increased from 3% to 5% from 2015 to 2016, while the partially bleached category increased from 15% to 20% of the colonies. Overall, Honduras was the most affected country (73%) followed by Mexico (47%) then Guatemala (33%) and Belize (23%). Some of the main reef building coral species were also the most severely bleached, in terms of percent of colonies partly or fully bleached, including *Orbicella franksii* (42%), O. annularis (34%) and *O. faveolata* (26%) and *Undaria tenuifolia* (35%). The two-year $40,000 project involved 23 sub-grants organized by the four HRI country coordinators and administered by the Mesoamerican Reef Fund, which is establishing an Emergency Response Fund that could assist with future events.

El Arrecife Mesoamericano se extiende por más de 100km a lo largo de las costas caribeñas de México, Belice, Guatemala y Honduras. Esta zona ha experimentado al menos seis episodios masivos de blanqueamiento de coral desde el primer registro en 1995, incluyendo el tercer evento global (2015/2016), que afecta actualmente a los arrecifes nivel global. Con el fin de evaluar el grado de blanqueamiento y sus posibles impactos en la región de Mesoamérica, la Iniciativa de Arrecifes Saludables (HRI) llevó a cabo un Plan Regional de Respuesta de Emergencia de Blanqueamiento de Coral en colaboración con 19 organizaciones regionales. Las organizaciones se movilizaron rápidamente en toda la región del Sistema Arrecifal Mesoamericano (SAM) para monitorear más de 100 sitios en octubre/noviembre de 2015 y de nuevo en 2016 evaluando un total de 33,890 corales. En general, el SAM fue moderadamente afectado por este evento de blanqueamiento, con el 36% de los corales "afectados" en 2015 y el 49% afectados en 2016. En ambos años aproximadamente la mitad de las colonias estaban pálidas y la mitad fueron parcialmente blanqueadas. El número de corales completamente blanqueados aumentó del 3% a 5% de 2015 a 2016,

mientras que la categoría parcialmente blanqueada aumentó de 15% a 20% de las colonias. En general, Honduras fue el país más afectado (73%), seguido por México (47%), Guatemala (33%) y Belice (23%). Algunas de las principales especies de corales que se fueron severamente blanqueadas, en términos de porcentaje de colonias parcialmente o totalmente blanqueadas, incluyen *Orbicella franksii* (42%), *O. annularis* (34%) y *O. faveolata* (26%) y Undaria tenuifolia (35%). El proyecto de dos años de $40,000 involucró 23 subsidios organizados por los cuatro coordinadores de países de HRI y administrados por el Fondo Arrecifal Mesoamericano, que está estableciendo un Fondo de Respuesta a Emergencias que podría financiar futuros eventos de blanqueamiento.

Keywords: coral reefs, bleaching index, Mesoamerican region, degree heating weeks

ON THE RELATIONSHIP BETWEEN PARTIAL MORTALITY AND THE DEMOGRAPHICS OF *ACROPORA CERVICORNIS*

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Understanding how coral populations respond to partial mortality of the colonies is essential to evaluate population persistence under unfavorable environmental conditions, such as elevated sea water temperature, high sedimentation rates, and strong wave surge due to storms. Coral species that contribute significantly to the structure and function of coral reefs are of interest. The aim of this study was to test the hypothesis that partial mortality sets back the demographic performance of the threatened reef-builder coral *Acropora cervicornis*. We followed, for two years, the fate (growth and survival) of colonies with varying degree of partial mortality indicated by tissue loss, at two reefs in Puerto Rico. Partial mortality limited colony growth and increased the odds of death. A simple stage-based matrix population model indicated that at an increasing number of colonies with more than 20% of partial mortality, the time to reach a quasi-extinction level (set at 25% of the original population size) was reduced considerably. Thus, the partial mortality of colonies should be taken into consideration when evaluating the population dynamics of *A. cervicornis*.

Keywords: *Acropora cervicornis*, partial mortality, extinction, colony conditions

MULTI-AGENCY RESCUE OF THE THREATENED PILLAR CORAL ALONG THE FLORIDA REEF TRACT

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Pillar coral (*Dendrogyra cylindrus*) is a rare but conspicuous Caribbean coral, and the only species in its genus. It was listed as threatened under the U.S. Endangered Species Act in 2014 by NOAA Fisheries due to a combination of threats including ocean warming, ocean acidification, and disease. Once a species is added to the Endangered Species List, NOAA Fisheries engages in planning and implementation of recovery actions to provide for the conservation of the species. In 2016, a severe mortality event, beginning in 2014, affecting the entire Florida population of pillar coral was reported. The dramatic decline prompted a multi-agency coordinated effort to "rescue" fragments of as may extant genotypes as possible to provide a genetic "Noah's Ark" as well as investigate viable restoration techniques. The high-level of collaboration and dedication by the partner agencies, catalyzed by the species' threatened status, is a success story despite the dire status of the Florida population.

Keywords: Threatened, Endangered Species Act, pillar coral, *Dendrogyra cylindrus*, restoration, Florida, disease.

COLLAPSE, RESCUE, AND POTENTIAL RESTORATION OF FLORIDA'S PILLAR CORAL *DENDROGYRA CYLUNDRUS.*

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The pillar coral *Dendrogyra cylindrus* has undergone a catastrophic 70% population decline on the Florida Reef Tract since 2014 due to back-to-back bleaching events and an expanding disease outbreak. The estimated number of surviving genotypes within the population has declined from 142 to 79, and the Florida inhabitants are assumed to be reproductively extinct and at high risk for regional extinction. In response to this decline, restoration efforts were rapidly scaled up from experimental microfragging and larval rearing trials to full-scale genetic banking. From an estimated 142 genotypes along the Florida Reef Tract, an estimated 70 have gone extinct. Of the remaining genotypes, 20% exist only within onshore conservation and research facilities. These facilities are researching disease treatment, fragmenting strategies, and methods to promote tissue growth. Juvenile settlement and growth of the species has also been achieved from wild-spawning parents. Partnerships between federal, state, academic, and non-profit agencies has allowed for the rapid response and care for this species to salvage what remains of the population for future restoration.

Keywords: Restoration, Disease, *Dendrogyra cylindrus* Spawning, Population, Coral, Florida

DEVELOPMENT OF A MOLECULAR ASSAY FOR CARIBBEAN CORAL IDENTIFICATION

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As coral cover has declined throughout the Caribbean, interest in determining the potential for reef recovery via natural recruitment processes has increased. Studies investigating recruitment processes have been hampered by the difficulty of identifying larvae or recently settled recruits that often lack distinguishing morphological characters. To overcome these constraints, the development of molecular tools to recognize species at early life stages are required. In this study, we investigated the utility of targeting the non-coding internal transcribed spacer (ITS) regions with a multiplex PCR assay to identify common Caribbean coral species. To design this assay, we developed a database of ITS sequences for 17 different Caribbean scleractinian coral species that are important reef builders, or are common. Analyzing the ITS region, we detected sufficient genetic variation to allow for potential differentiation of nine Caribbean coral species to the genus level, and eight to the species level. We subsequently designed a set of three genus-specific primers (with a total of seven included species) and six species-specific primers for use in a single-step nested multiplex PCR protocol that facilitates coral identification. We were unable to successfully design primers for five species that were included in the database. While still under development, this genetic assay shows significant promise as an inexpensive and relatively straightforward method of identifying planula larvae and recently settled coral recruits to the genus or species level. The increased accuracy and abbreviated timeframe offered by this technique for identifying larvae and recruits will be a valuable tool in evaluating Caribbean reef recovery moving forward.

Keywords: Corals, molecular assay, single-step nested multiplex PCR, internal transcribed spacer regions 1 and 2

SARGASSUM INFLUXES: UNDERSTANDING THE CAUSES AND CONSEQUENCES IN THE CARIBBEAN

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Since 2011, the Caribbean has been affected by periodic mass influxes of pelagic *Sargassum* seaweed. These events have resulted in mass inundating of coastlines, harbors, bays and beaches by the weed and significant disruption of the fisheries and tourism sectors across the region with social and economic consequences. There have also been negative impacts to sensitive coastal habitats and species produced by the decomposition of the algae. These events, which are unprecedented in the southern, central and eastern Caribbean as far back as records exist, have caused many misconceptions and confusion about the causes and sources of the massive *Sargassum* influxes to this region, raising questions about whether they represent a 'new norm' under the current climate change scenario. This presentation answers the call for better communication of the current scientific knowledge regarding *Sargassum* influxes and presents the progress with developing predictive models to provide early warning of future events. It also highlights the many areas in need of further research and monitoring.

Keywords: *Sargassum* influxes, Caribbean, Climate Change.

STONY CORAL MORTALITY ASSOCIATED WITH THE DISEASE OUTBREAK ALONG THE SOUTHEAST FLORIDA REEF TRACT

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The northern extent of the Florida Reef Tract, offshore Southeast Florida (USA) is formed by a series of linear reef structures along a highly developed coastline. The Southeast Florida Coral Reef Evaluation and Monitoring Project (SECREMP) has monitored reef conditions in this region via annual image analysis and transect data since 2003 with the addition of stony coral, gorgonian and barrel sponge demographic data in 2012. The project currently monitors 22 permanent sites distributed along the Florida Reef Tract from Martin County to Miami-Dade County. Starting in late 2014, increased disease prevalence, much appearing to be white-plague type, and disease related mortality were reported throughout the region. By summer 2016, significant region-wide declines in *Dichocoenia stokesii*, *Meandrina meandrites*, and *Montastraea cavernosa* densities were recorded. Significant *M. cavernosa* loss, one of the major contributors to regional stony coral cover, is of particular concern. *M. cavernosa* has historically been considered one of the hardiest species that commonly has large colonies on the reef. With disease observations continually reported for more than two years, it appears that the northern portion of the Florida Reef Tract is experiencing the greatest multi-species stony coral mortality event in recent times.

Keywords: Coral Disease, Southeast Florida, Coral Mortality, Disease Event

STUDY OF DISCRETE MORPHOMETRIC CHARACTERISTICS OF SAGITTAE OTOLITH OF LIONFISH (*PTEROIS VOLITANS*) IN PUERTO MORELOS

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The lionfish Pterois volitans, is the first species of non-native marine fish to settle along the western Atlantic coast of the USA, Caribbean Sea, and Gulf of Mexico, in part because of the wide-ranging environmental tolerances. This has added more concerns to the managers of the region's marine resources. Several authors have provided evidence that fish otolith shapes are species-specific, it is widely accepted that shape of sagittae otolith analysis can be used for age, population and species identification studies, and can provide necessary and relevant information for ecological studies. The study of shape properties is an important topic in pattern recognition and digital images processing, where the information is in the discrete domain, for this reason the implementation of discrete morphometric descriptors is necessary to obtain otolith shape characteristics from digital images, for this reason the purpose of this study was to analyze and quantify shape disparities of lionfish sagittae otoliths by the discrete morphometric measurements, for example tortuosity, compactness, and Euler number in the discrete domain. The left and right sagittae from 104 specimens of P. volitans were analyzed. All specimens were caught by fisher cooperative of Puerto Morelos, Quintana Roo, Mexico. All digital images were acquired by a Nikon DS-Ri1 camera coupled to a Nikon LMZ15000 optic microscope. In this case of the Mexican Caribbean, the morphological analysis did not show a particular pattern to classify the lionfish by classic descriptors. Thus, it was necessary to implement morphometric descriptors in the discrete domain that may help to characterize the otolith shape of the Caribbean lionfish. This study presents results of these discrete descriptors, on the similarity or dissimilarity between the left and right sagittae of P. volitans, and to asses and quantify the shape changes through the ontogeny of lionfish.

El pez león, *Pterois volitans*, es de las primeras especies marinas no nativas que se han establecido a lo largo de la costa atlántica occidental de los Estados Unidos de América, el mar Caribe y el Golfo de México, en parte debido a que tiene amplias tolerancias ambientales. El establecimiento del pez león a lo largo de estas áreas marinas ha aumentado las preocupaciones que enfrentan los administradores de los recursos marinos de la región.
Varios autores han aportado pruebas de que la forma de los otolitos en peces es específica de cada especie. El análisis de la forma del otolito sagitario puede utilizarse para estudios de edad, identificación de especies y stocks pesqueros o poblaciones, y puede proporcionar información necesaria y relevante para estudios ecológicos. El estudio de las propiedades de la forma es un tema importante en el reconocimiento de patrones y procesamiento de imágenes digitales, donde la información está en un dominio discreto, por esta razón la implementación de descriptores morfométricos discretos es necesaria para la extracción de características de forma a partir de imágenes digitales. El propósito de este estudio fue analizar y cuantificar las variaciones de forma de los otolitos sagita del pez león a partir de mediciones morfométricas discretas como por ejemplo la tortuosidad, la compacidad y el número de Euler en el dominio discreto. Se analizaron los otolitos sagita izquierdo y derecho de 104 ejemplares de *P. volitans*. Todas las especies fueron capturadas por la cooperativa pesquera de Puerto Morelos, Quintana Roo, México. La adquisición de imágenes digitales de

otolitos fue realizada por una cámara Nikon DS-Ri1 acoplada a un microscopio óptico Nikon LMZ15000. En este caso del pez león del Caribe mexicano, el análisis morfológico no mostró un patrón morfológico particular que nos ayude a clasificar esta especie a partir de descriptores morfométricos clásicos, por lo que fue necesario implementar descriptores morfométricos en el dominio discreto que nos ayudaran a caracterizar la forma del pez león. Este estudio presenta resultados de estos descriptores discretos sobre la similitud o disimilitud entre los otolitos sagita izquierdos y derechos de *P. volitans,* para corroborar y cuantificar los cambios en la forma de los otolitos a través de la ontogenia del pez león.

Keywords: Discrete morphometry, Lion fish, Puerto Morelos, Pattern recognition

DISEASE RESISTANCE IN THE THREATENED STAGHORN CORAL, *ACROPORA CERVICORNIS*

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The staghorn coral, *Acropora cervicornis*, is a major reef-building scleractinian coral found throughout Florida and the Caribbean that experienced dramatic population declines starting in the late1970s. The declines are attributed primarily to white-band disease (WBD and coral bleaching, and other tissue loss syndromes. Previous research in Panama indicates that disease-resistant genotypes exist. It is unknown if disease resistant genotypes exist in Florida Keys populations. We tested the potential for rapid tissue loss (RTL) resistance among 48 *A. cervicornis* genotypes maintained in a Florida Keys nursery by grafting active disease fragments to apparently healthy fragments. Tissue degradation was documented visually by the presence or absence of RTL (denoted by a characteristic margin where the zooxanthellate tissue is denuded from the skeleton), followed by histological analysis to further characterize potential tissue degradation. In this preliminary disease screening, 41 out of 48 genotypes did not show signs of rapid tissue loss transmission after five days. Only two control fragments showed signs of disease transmission. Continued histological analysis and a highly replicated disease transmission study in 2017 will help confirm disease resistance. These results will help inform and potentially increase the efficacy of future management strategies of *Acropora* populations.

El coral cuerno de ciervo, *Acropora cervicornis*, es uno de los mayores constructores de arrecifes de coral desde Florida hasta el Mar Caribe. Este coral escleractinio ha experimentado dramáticos descensos en sus poblaciones desde 1970. Las pérdidas de esta especie se han atribuido al blanqueamiento de coral, a la enfermedad de la banda blanca y a otros síndromes de pérdida de tejido. Investigaciones anteriores han indicaron que genotipos resistentes a dichas enfermedades existen en Panamá, sin embargo, hasta el momento no existe información de los genotipos resistentes en las poblaciones de los Cayos de la Florida. El presente estudio analizó la resistencia a la pérdida de tejido en 48 genotipos de A. cervicornis de una guardería de los Cayos de la Florida, mediante el injerto de fragmentos con enfermedad activa en fragmentos aparentemente sanos. La degradación de tejido fue documentada mediante análisis visual de presencia o ausencia de pérdida de tejido (exhibida por el margen característico en donde se presenta el tejido de la zooxantela separado del esqueleto coralino desnudo), así como el análisis histológico para caracterizar la degradación potencial de los tejidos. En el análisis preliminar, 41 de 48 genotipos no mostraron signos de transmisión del síndrome de pérdida de tejido después de cinco días de exposición. Los análisis histológicos posteriores y las réplicas del estudio de transmisión en 2017, ayudarán a confirmar la resistencia de los genotipos. Estos estudios en conjunto contribuirán a informar e incrementar la eficacia de las estrategias de manejo de las poblaciones de *Acropora* en el futuro.

Keywords: Coral, Disease, Acropora, Histology, Restoration

RECENT INFLUX OF PELAGIC *SARGASSUM* ONTO THE CUBAN COASTLINE

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In 2011, pelagic *Sargassum* in very large masses, was observed for the first time in the Tropical North Atlantic from Africa to the NE coast of South America and the eastern Caribbean. At first it was thought to arrive by spreading southward from the Sargasso Sea. But efforts at determining its origin suggested that it most likely was 'seeded' into the tropics and bloomed under favorable conditions. Satellite imagery shows that it is increasing over time and not a temporary condition. The *Sargassum* events has significantly impacted marine fisheries, shorelines, embayments and reefs of nations from the Lesser Antilles to NW Brazil and West Africa. In more recent years it has created major impacts within the Caribbean. In late October 2016, pelagic *Sargassum* in unusually large quantities was observed floating just offshore along the Malecón in Havana, Cuba. At the same time, mats and lines were washing ashore along Cayo Cocos, Cuba in such quantities as to require clean-up activities on the resort beaches. This ~450 Km stretch of coast has previously received pelagic Sargassum along its shoreline, but never has such a large and extensive event been recorded. It was thought that the small amounts previously received were coming from the Sargasso Sea through the Old Bahamas Channel or into the Caribbean via the Mona Passage. Using archived surface current data from a numerical ocean current model (HYcom), the *Sargassum* in this event was back tracked from observed landings in Havana and Cayo Cocos through the Caribbean and into the Tropical region of the Atlantic, passing through the Lesser Antilles in the previous July of 2016 as confirmed by satellite. Although the event in Cuba was relatively light compared to elsewhere in the Caribbean and the Tropical Atlantic, it does demonstrate that preparations for its influx should be made.

Keywords: pelagic *Sargassum*, currents, bloom, Caribbean, Tropical Atlantic

CONSECUTIVE WINTER BLEACHING EVENTS OBSERVED ON DEEPER REEF SITES NEAR CARRIE BOW CAY, BELIZE

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Ongoing reef monitoring efforts included bi-annual surveys at 24 permanent transects in the vicinity of Carrie Bow Cay, Belize. Starting in 2011, a comprehensive protocol assessed the abundance, species diversity, size distribution and condition of scleractinian corals and fishes on transects spanning four depth habitats from 5m-20m. Surveys from 2015-2017 recorded significant bleaching events persisting well into the winter months of December 2015 and January 2017. The number of colonies and species affected was positively correlated with depth. The greatest impact was observed at 20m. In 2015, bleaching recorded in December was largely sublethal, with less than 5% of bleaching colonies experiencing tissue mortality. However a second bleaching event, beginning in October 2016 and persisting into January 2017 produced significant amounts of coral mortality. Possible drivers including patterns of temperature, salinity, turbidity are explored.

Keywords: Coral Bleaching, Reef Monitoring

DETERMINATION OF THE DEGRADATION RATE OF LIONFISH EDNA IN THE LABORATORY

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Detection of the invasive lionfish in highly complex tropical ecosystems will require more than visual surveys and population control efforts will be more successful if lionfish removal is focused on areas known to have lionfish. Lionfish hunting is an effective strategy for controlling the lionfish population within recreational diving limits; especially on oceanic islands with fringing reefs. Mangrove habitats are difficult ecosystems for lionfish hunting and new methods are needed to detect lionfish. Mangroves are important areas for juvenile reef fish and some species require mangroves in the juvenile stages. In freshwater ecosystems, environmental DNA (eDNA) techniques have become widely used due to their success in detecting target species, and recently eDNA techniques started being utilized in marine ecosystems. An important component for determining lionfish density in mangroves will be to determine the degradation rate of lionfish eDNA in the laboratory. To determine the average degradation time of lionfish eDNA, water samples from aquariums that held one lionfish for 24 h were sampled over nine days. Water was filtered to extract DNA from seawater samples. DNA was amplified, and gels were run using electrophoresis. The degradation rates determined using this technique will be used in parallel with another study in our laboratory to detect lionfish DNA on coral reefs where the exact location of the lionfish is known. This study will result in the ability to estimate the presence on lionfish within an important parameter; the rate of degradation and that will contribute to developing the technique required to determine locations of lionfish for removal.

Keywords: Lionfish, environmental DNA, eDNA, degradation

ADAPTATION AND RESILIENCE IN A CHANGING CLIMATE: CRYPTIC *SYMBIODINIUM* SP. IN FLORIDA'S PILLAR CORAL OFFER A GLIMMER OF HOPE

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Like many coral reefs worldwide, the Florida Reef Tract (FRT) experienced two consecutive hyperthermal bleaching events during the summers of 2014 and 2015. The iconic and unique pillar coral, *Dendrogyra cylindrus*, suffered severe bleaching throughout the 320 km FRT. While all D. cylindrus colonies bleached severely during summer 2014, one Upper Keys site appeared more resistance to bleaching during the 2015 event and returned to normal coloration more quickly than some sites in the Middle and Lower Keys. This pattern of resistance was linked to a shift of the dominant Symbiodinium species associated with *D. cylindrus*. Following the first bleaching event in September 2014, we observed a rapid change in dominance from the typically hosted *Symbiodinium* 'dendrogyrum' to the cryptic S. 'meandrinium', where the dominance of this latter persisted throughout the second bleaching event in August/September 2015 and through April 2016. The fine taxonomic resolution achieved in this study through the use high-throughput amplicon sequencing of the chloroplast 23S hypervariable region allowed the discovery of an ecologically relevant shift and a glimmer of hope for adaptation and resilience for corals in a changing climate.

Keywords: adaptation, *Dendrogyra cylindrus*, Florida Reef Tract, hyperthermal bleaching, pillar coral, resilience

CARBON SOURCES SUPPORTING FOOD CHAINS IN A MANGROVE FOREST AND ADJACENT INTERTIDAL MUDFLATS: A STABLE ISOTOPE TECHNIQUE FOR ASSESSING ECOSYSTEM CONNECTIVITY

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The abundance of food resources has been promoted as one of the principal attributes of mangroves and mudflats as nursery habitats for juvenile fish. Identifying the primary producers sustaining these food webs is the foundation for informed management plans to conserve biodiversity and commercial resources in a habitat mosaic. These habitats are also thought to be interlinked through diurnal or tidal fish migrations and carbon exchange. We use carbon and nitrogen stable isotope analysis (SIA) of primary producers, benthic and planktonic meiofauna, invertebrates, fishes and birds to identify the autotrophs underpinning food webs in a mangrove forest and adjacent intertidal mudflat in the Gulf of Paria, Trinidad and Tobago. We find isotopically distinct food webs in the two habitats, and even isotopic distinctions for the same species collected in both habitats. MixSIAR mixing models show that mangrove carbon does not support fish populations in an adjacent mudflat ecosystem and may only partially support fishes in mangroves along with other carbon sources. This reaffirms findings from previous studies that question the role of mangrove carbon in food webs and the 'outwelling' hypothesis. In both habitats, phytoplankton and/or benthic microalgae support foodwebs for fishes and waterfowl. We observed little evidence of connectivity between the two habitats in terms of carbon exchange and feeding migrations for several planktivorous and demersal fish species. We present the possible reasons for this habitat isolation and what it means for management of fish nursery habitats.

Keywords: mangrove, mudflat, fish, nursery, isotopes, food webs

IMPACT OF WATER TEMPERATURE INCREASE IN THE PHOTOSYNTHESIS AND CALCIFICATION/GROWTH RATE OF THREE LIFE STAGES OF *PORITES ASTREOIDES*

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A rise in sea surface temperature can affect corals physiological processes in different ways during each development stage. Here, we determine the impact of temperature increase on symbiont photosynthesis and growth/calcification of coral host in *Porites astreoides* at different developmental stages which include swimming larvae, newly settled juveniles and adults. Photosynthetic efficiency (Fv/Fm') of symbionts in adults and larvae were measured using a Diving PAM (Walz). Calcification rates of adults were measured using the buoyant weight technique, and the growth rates of the swimming larvae and newly settled juveniles were measured using light microscopy and Image J-Fiji software. The temperature treatments include 28°C, an intermediate mildly stressful temperature of 30°C, and a third treatments of 32°C which is the threshold for bleaching, Photosynthetic efficiency of the swimming larvae was not affected by temperature increase, meanwhile, newly settled juveniles exhibited more variation in Fv/Fm values. The adult stages showed a dramatic decrease in photosynthetic efficiency. No significant changes with increase in temperature were observed in growth rates for the swimming larvae and newly settled juveniles. However, the calcification rate of the adults slightly increased at higher temperature. Thus, the susceptibility to thermal stress varies depending on the life stage.

Keywords: *Porites astreoides*, temperature increase, photosynthesis, calcification, life stages

GRAZING BY GREEN TURTLES INDUCED A COMMUNITY SHIFT FROM CLIMAX TO EARLY SUCCESSIONAL SPECIES IN THE CARIBBEAN.

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In the Caribbean, Green turtles (*Chelonya mydas*) practice rotational grazing where *Thalassia testudinum* grazing patches are used for up to 2 years, after which these patches are abandoned. This study examined the effects of simulating grazing (clipping) by green turtles on both ungrazed and grazed abandoned seagrass patches during different periods. Treatments included 0 (control, no grazing), 4, and 8 months of simulating clipping, and treatments for grazed abandoned patches were 8 months of clipping and 8 months of recovery without clipping. Grazing resulted in a decrease in shoot density and below ground biomass for the preferred turtle food *T. testudinum*, while an increase in these parameters was observed for the faster growing seagrass *Syringodium filiforme*. By contrast, *T. testudinum* leaf length, leaf width, foliar shoot density, and biomass were negatively affected by the simulated grazing. As grazing time increased, *T. testudinum* leaf C/N-ratios decreased and ammonium pore water levels increased, suggesting a reduced demand for nitrogen by *T. testudinum*. Patches with 8 months of clipping after abandonment showed rhizome soluble carbohydrate content and leaf tannin concentration greatly reduced, suggesting a total depletion of energetic and carbon reserves. This latter was confirmed by an increase in carbohydrate reserves in *T. testudinum* from the abandoned patches that had recovered for 8 months. This time series showed that grazing on *T. testudinum* cause carbon depletion and increase the ammonia in the sediments. Ammonia is a resource available for the fast growing *S. filiforme*, causing a community shift from *T. testudinum* into *S. filiforme*.

En el Caribe la tortuga verde (*Chelonya mydas*) practica pastoreo rotacional en pastizales marinos dominados por *Thalassia testudinum*, manteniendo parcelas ramoneadas hasta por dos años que posteriormente son abandonadas. Este estudio analizó el efecto de la herbivoría por tortugas utilizando parcelas sin pastoreo y parcelas abandonadas de manera natural. Los tratamientos consistieron en diferentes niveles de intensidad de herbivoría (tiempo). En parcelas sin pastoreo previo se estableció el control (nivel 0), y dos niveles adicionales simulando el pastoreo de tortugas (clipping) durante 4 y 8 meses respectivamente. En parcelas abandonadas, se estableció un tratamiento con herbivoría artificial por 8 meses y uno más con 8 meses de recuperación (no herbivoría simulada). El pastoreo resultó en una disminución en la densidad de haces y biomasa subterránea para la especie preferida por las tortugas *T. testudinum*. Los mismos parámetros incrementaron para la especie de crecimiento rápido *Syringodium filiforme*. Al aumentar el tiempo de pastoreo, disminuyó la longitud, ancho y proporción de C/N en hojas de *T. testudinum*. En cambio la concentración de amonio incrementó en el agua intersticial del sedimento, que sugiere una disminución en la demanda de nitrógeno por *T. testudinum*. Las parcelas abandonadas y con pastoreo artificial por 8 meses, mostraron las menores

concentraciones de carbohidratos solubles en los rizomas y de contenido de taninos en hojas, como una posible causa de la reducción en sus reservas energéticas y de carbono. Esto concuerda con el aumento de carbohidratos solubles de *T. testudinum* en las parcelas abandonadas naturalmente pero con 8 meses de recuperación. Se sugiere que una pérdida en las reservas de carbohidratos solubles en los rizomas de *T. testudinum* y el aumento de amonio disponible en el sedimento, favorecen un cambio en la comunidad de pastos marinos hacia una mayor abundancia de especies de crecimiento rápido como *S. filiforme*.

Keywords*: Chelonya mydas,* seagrass, grazing, clipping, *Thalassia testudinum, Syringodium filiforme*

MARINE PROTECTED AREAS AND CORAL REEF RESILIENCY, CAYMAN ISLANDS

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Coral reefs in the Caribbean region have experienced widespread coral cover loss over the past 3 decades, primarily due to hurricanes, coral disease outbreaks, loss of "keystone" herbivores, coral bleaching, eutrophication and overfishing. Centrally located in the NW Caribbean, the Cayman Islands established a system of Marine protected areas in 1986. The current study aims to assess the benthic community composition at 40 sites around Grand Cayman, Little Cayman and Cayman Brac, for the years 2009, 2012, 2015 and 2016. Benthic community was analyzed and compared between MPAs and non-MPA areas across islands on their shallow and deep reef terrace reefs. Results revealed a low hard coral cover average across islands in 2009 of 9.5% and Macro-algae showing 79.44% cover to a much high coral cover average in 2016 of 21.7%, and a much lower macro algae cover of 42.2%. The remaining % benthic cover was composed of soft corals, crustose coralline algae, sand, rubble and dead corals. Comparisons between the three islands showed that the less developed Sister Islands had a higher coral cover compared to the more developed Grand Cayman. Additionally, the macro algal cover was higher in Grand Cayman and Cayman Brac. The two most abundant coral species within the waters of the Cayman Islands comprised the encrusting corals *Agaricia* and *Porites* spp. The high percentage cover of macro algae cover, which predominantly composed of *Dictyot*a and *Lobophora*. Analysis showed a higher species abundance along the southern coastlines and within the shallower reef systems. A temporal analysis demonstrated a significant increase in the cover of hard coral species across all the islands, with a net decrease in the macro algae cover. Following several bleaching and hurricane events during recent years, the Cayman Islands showed positive signs of recovery and suggest the presence of resilient reefs, especially within the MPAs.

Los arrecifes de coral en la región del Caribe han experimentado pérdidas generalizadas de cubierta coralina durante las últimas 3 décadas, principalmente debido a huracanes, brotes de enfermedades de coral, pérdida de herbívoros "clave", blanqueamiento de corales, eutrofización y sobrepesca. El presente estudio tiene como objetivo evaluar la composición de la comunidad bentónica en 40 sitios alrededor de Grand Caiman, Little Caiman y Caiman Brac, para los años 2009, 2012, 2015 y 2016. La comunidad bentónica fue analizada y comparada entre áreas protegidas marinas y áreas no protegidas a través de islas en sus arrecifes de arrecifes superficiales y profundos. Los resultados revelaron un promedio de cobertura de coral duro bajo en las islas en 2009 de 9.5% y Macroalgas mostrando un 79.44% cubriendo un promedio de cubierta de coral muy alto en 2016 de 21.7% y una cobertura de macro algas mucho más baja de 42.2%. El resto de la cubierta bentónica estaba compuesta por corales blandos, algas coralinas crustosas, arena, escombros y corales muertos. Las comparaciones entre las tres islas mostraron que las islas hermanas menos desarrolladas tenían una cubierta de coral más alta en comparación

con el Grand Caiman más desarrollado. Además, la cobertura macro algas fue mayor en Gran Caimán y Caiman Brac. Las dos especies de coral más abundantes dentro de las aguas de las Islas Caimán comprendían los incrustantes corales *Agaricia* y *Porites* spp. El alto porcentaje de cobertura de algas macro cubiertas, que se compone principalmente de *Dictyota* y *Lobophora*. El análisis mostró una mayor abundancia de especies a lo largo de las costas del sur y dentro de los sistemas de arrecifes menos profundos. Un análisis temporal demostró un aumento significativo en la cubierta de especies de corales duros en todas las islas, con una disminución neta en la cobertura de macroalgas. Después de varios episodios de blanqueo y huracán durante los últimos años, las Islas Caimán mostraron signos positivos de recuperación y sugieren la presencia de arrecifes resistentes, especialmente dentro de las MPAs.

Keywords: Marine protected areas, Cayman Islands, Coral reef resilience

CORAL BLEACHING IN THE MESOAMERICAN REGION (2015-2016)

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The Mesoamerican Reef extends for over 100km across the Caribbean coasts of Mexico, Belize, Guatemala and Honduras. It has experienced at least six bleaching events since the first recorded in 1995, including the 2015/2016 third global mass bleaching event, currently affecting reefs worldwide. In order to assess the extent of coral bleaching and its potential impacts in the Mesoamerican region (MAR), the Healthy Reefs Initiative led a regional Coral Bleaching Emergency Response Plan in partnership with 19 regional organizations. Surveyors quickly mobilized across the MAR region to monitor over 100 sites in October/November 2015 and again in 2016 assessing a total of 33,890 corals. Overall, the Mesoamerican Reef was moderately affected by this bleaching event, with 36% of corals “affected” in 2015 and 49% affected in 2016. Both years approximately half of the colonies were pale and half were either partly of fully bleached. The number of fully bleached corals increased from 3% to 5% from 2015 to 2016, while the partially bleached category increased from 15% to 20% of the colonies. Overall, Honduras was the most affected country (73%) followed by Mexico (47%) then Guatemala (33%) and Belize (23%). Some of the main reef building coral species were also the most severely bleached, in terms of percent of colonies partly or fully bleached, including *Orbicella franksii* (42%), O. annularis (34%) and *O. faveolata* (26%) and *Undaria tenuifolia* (35%). The two-year $40,000 project involved 23 sub-grants organized by the four HRI country coordinators and administered by the Mesoamerican Reef Fund, which is establishing an Emergency Response Fund that could assist with future events.

El Arrecife Mesoamericano se extiende por más de 100km a lo largo de las costas caribeñas de México, Belice, Guatemala y Honduras. Esta zona ha experimentado al menos seis episodios masivos de blanqueamiento de coral desde el primer registro en 1995, incluyendo el tercer evento global (2015/2016), que afecta actualmente a los arrecifes nivel global. Con el fin de evaluar el grado de blanqueamiento y sus posibles impactos en la región de Mesoamérica, la Iniciativa de Arrecifes Saludables (HRI) llevó a cabo un Plan Regional de Respuesta de Emergencia de Blanqueamiento de Coral en colaboración con 19 organizaciones regionales. Las organizaciones se movilizaron rápidamente en toda la región del Sistema Arrecifal Mesoamericano (SAM) para monitorear más de 100 sitios en octubre/noviembre de 2015 y de nuevo en 2016 evaluando un total de 33,890 corales. En general, el SAM fue moderadamente afectado por este evento de blanqueamiento, con el 36% de los corales "afectados" en 2015 y el 49% afectados en 2016. En ambos años aproximadamente la mitad de las colonias estaban pálidas y la mitad fueron parcialmente blanqueadas. El número de corales completamente blanqueados aumentó del 3% a 5% de 2015 a 2016,

mientras que la categoría parcialmente blanqueada aumentó de 15% a 20% de las colonias. En general, Honduras fue el país más afectado (73%), seguido por México (47%), Guatemala (33%) y Belice (23%). Algunas de las principales especies de corales que se fueron severamente blanqueadas, en términos de porcentaje de colonias parcialmente o totalmente blanqueadas, incluyen *Orbicella franksii* (42%), *O. annularis* (34%) y *O. faveolata* (26%) y Undaria tenuifolia (35%). El proyecto de dos años de $40,000 involucró 23 subsidios organizados por los cuatro coordinadores de países de HRI y administrados por el Fondo Arrecifal Mesoamericano, que está estableciendo un Fondo de Respuesta a Emergencias que podría financiar futuros eventos de blanqueamiento.

Keywords: coral reefs, bleaching index, Mesoamerican region, degree heating weeks

ON THE RELATIONSHIP BETWEEN PARTIAL MORTALITY AND THE DEMOGRAPHICS OF *ACROPORA CERVICORNIS*

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Understanding how coral populations respond to partial mortality of the colonies is essential to evaluate population persistence under unfavorable environmental conditions, such as elevated sea water temperature, high sedimentation rates, and strong wave surge due to storms. Coral species that contribute significantly to the structure and function of coral reefs are of interest. The aim of this study was to test the hypothesis that partial mortality sets back the demographic performance of the threatened reef-builder coral *Acropora cervicornis*. We followed, for two years, the fate (growth and survival) of colonies with varying degree of partial mortality indicated by tissue loss, at two reefs in Puerto Rico. Partial mortality limited colony growth and increased the odds of death. A simple stage-based matrix population model indicated that at an increasing number of colonies with more than 20% of partial mortality, the time to reach a quasi-extinction level (set at 25% of the original population size) was reduced considerably. Thus, the partial mortality of colonies should be taken into consideration when evaluating the population dynamics of *A. cervicornis*.

Keywords: *Acropora cervicornis*, partial mortality, extinction, colony conditions

MULTI-AGENCY RESCUE OF THE THREATENED PILLAR CORAL ALONG THE FLORIDA REEF TRACT

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Pillar coral (*Dendrogyra cylindrus*) is a rare but conspicuous Caribbean coral, and the only species in its genus. It was listed as threatened under the U.S. Endangered Species Act in 2014 by NOAA Fisheries due to a combination of threats including ocean warming, ocean acidification, and disease. Once a species is added to the Endangered Species List, NOAA Fisheries engages in planning and implementation of recovery actions to provide for the conservation of the species. In 2016, a severe mortality event, beginning in 2014, affecting the entire Florida population of pillar coral was reported. The dramatic decline prompted a multi-agency coordinated effort to "rescue" fragments of as may extant genotypes as possible to provide a genetic "Noah's Ark" as well as investigate viable restoration techniques. The high-level of collaboration and dedication by the partner agencies, catalyzed by the species' threatened status, is a success story despite the dire status of the Florida population.

Keywords: Threatened, Endangered Species Act, pillar coral, *Dendrogyra cylindrus*, restoration, Florida, disease.

COLLAPSE, RESCUE, AND POTENTIAL RESTORATION OF FLORIDA'S PILLAR CORAL *DENDROGYRA CYLUNDRUS.*

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The pillar coral *Dendrogyra cylindrus* has undergone a catastrophic 70% population decline on the Florida Reef Tract since 2014 due to back-to-back bleaching events and an expanding disease outbreak. The estimated number of surviving genotypes within the population has declined from 142 to 79, and the Florida inhabitants are assumed to be reproductively extinct and at high risk for regional extinction. In response to this decline, restoration efforts were rapidly scaled up from experimental microfragging and larval rearing trials to full-scale genetic banking. From an estimated 142 genotypes along the Florida Reef Tract, an estimated 70 have gone extinct. Of the remaining genotypes, 20% exist only within onshore conservation and research facilities. These facilities are researching disease treatment, fragmenting strategies, and methods to promote tissue growth. Juvenile settlement and growth of the species has also been achieved from wild-spawning parents. Partnerships between federal, state, academic, and non-profit agencies has allowed for the rapid response and care for this species to salvage what remains of the population for future restoration.

Keywords: Restoration, Disease, *Dendrogyra cylindrus* Spawning, Population, Coral, Florida

DEVELOPMENT OF A MOLECULAR ASSAY FOR CARIBBEAN CORAL IDENTIFICATION

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As coral cover has declined throughout the Caribbean, interest in determining the potential for reef recovery via natural recruitment processes has increased. Studies investigating recruitment processes have been hampered by the difficulty of identifying larvae or recently settled recruits that often lack distinguishing morphological characters. To overcome these constraints, the development of molecular tools to recognize species at early life stages are required. In this study, we investigated the utility of targeting the non-coding internal transcribed spacer (ITS) regions with a multiplex PCR assay to identify common Caribbean coral species. To design this assay, we developed a database of ITS sequences for 17 different Caribbean scleractinian coral species that are important reef builders, or are common. Analyzing the ITS region, we detected sufficient genetic variation to allow for potential differentiation of nine Caribbean coral species to the genus level, and eight to the species level. We subsequently designed a set of three genus-specific primers (with a total of seven included species) and six species-specific primers for use in a single-step nested multiplex PCR protocol that facilitates coral identification. We were unable to successfully design primers for five species that were included in the database. While still under development, this genetic assay shows significant promise as an inexpensive and relatively straightforward method of identifying planula larvae and recently settled coral recruits to the genus or species level. The increased accuracy and abbreviated timeframe offered by this technique for identifying larvae and recruits will be a valuable tool in evaluating Caribbean reef recovery moving forward.

Keywords: Corals, molecular assay, single-step nested multiplex PCR, internal transcribed spacer regions 1 and 2

SARGASSUM INFLUXES: UNDERSTANDING THE CAUSES AND CONSEQUENCES IN THE CARIBBEAN

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Since 2011, the Caribbean has been affected by periodic mass influxes of pelagic *Sargassum* seaweed. These events have resulted in mass inundating of coastlines, harbors, bays and beaches by the weed and significant disruption of the fisheries and tourism sectors across the region with social and economic consequences. There have also been negative impacts to sensitive coastal habitats and species produced by the decomposition of the algae. These events, which are unprecedented in the southern, central and eastern Caribbean as far back as records exist, have caused many misconceptions and confusion about the causes and sources of the massive *Sargassum* influxes to this region, raising questions about whether they represent a 'new norm' under the current climate change scenario. This presentation answers the call for better communication of the current scientific knowledge regarding *Sargassum* influxes and presents the progress with developing predictive models to provide early warning of future events. It also highlights the many areas in need of further research and monitoring.

Keywords: *Sargassum* influxes, Caribbean, Climate Change.

A NEW APPROACH TO UNDERSTANDING THE ETIOLOGY OF BLACK BAND DISEASE

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Black band disease (BBD), a globally distributed, cyanobacterial-dominated, polymicrobial disease of corals, has been studied using ecological and microbiological approaches since the 1970s. This body of work has led to many insights that include the physiological flexibility of BBD bacterial community members (photosynthetic, heterotrophic, lithotrophic); production of toxins (cyanotoxins and sulfide), including synergy between toxins; generation of oxygen/sulfide microenvironments; coral host susceptibilities; geographic distributions and patterns of disease spread; the existence of a temperature threshold; the presence of quorum sensing signaling systems; ultrastructural effects on host corals; and more. Similarly, many research groups have carried out sequencing studies targeting the 16S rRNA gene, which has led to a large data base of the diverse taxonomic identities of BBD community members. The most recent approach to studying BBD makes use of metagenomics, including metagenomes of the BBD consortium using BBD community DNA and metagenomes of cultures of the predominant BBD cyanobacteria. The latter includes genomes of associated bacteria that may or may not be symbiotic. Exciting new information derived from these new metagenomic analyses of BBD includes the finding of high numbers of CRISPR and Cas gene sequences, suggesting a completely unexplored role of viruses in this disease. This talk will discuss the ways in which the ecological/physiological/16S rRNA data bases can be used as a guide to mine the vast metagenomic data sets, and in turn how annotated sequences in the metagenomes can provide important clues to further explore BBD using microbiological/physiological approaches. This synergistic approach will most certainly lead to new laboratory-based studies such as assessing how viruses interact with BBD bacterial isolates.

Keywords: Black band disease, metagenomics, etiology, ecophysiology

NUTRIENT LOADING HINDERS MECHANISMS INVOLVED IN THE EPIGENETIC MAINTENANCE OF GENOME INTEGRITY IN THE STONY CORAL *ACROPORA CERVICORNIS*

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Coral reefs are particularly susceptible to the effects of global change, causing widespread coral bleaching and mortality. Nutrient pollution and increasing sea surface temperatures, two primary drivers of global change in the oceans, impact coral organismal physiology making predictions of coral survival very pessimistic. While multiple studies have addressed the physiological effects and ecological consequences of global change in corals, the molecular mechanisms underlying their acclimation responses to these stressors are still uncertain. Here, we aim to provide insights into how epigenetic modifications (responsible for phenotypic changes caused by heritable modifications in gene expression without changes in the DNA sequence) participate in coral acclimation responses during exposure to nutrient pollution. For that purpose, we combined field experiments in the Florida Keys with physiological and epigenetic analyses using the stony coral *Acropora cervicornis* as model system. Accordingly, coral fragments were exposed to different levels of nitrogen and phosphorous enrichment for 5 weeks in the field (Pickles Reef, Key Largo, FL). Coral samples were collected at different time intervals during experiments and subsequently analyzed for nutrient content and epigenetic modifications (DNA methylation and histone modifications). Our results revealed rapid changes in total DNA methylation levels in response to nutrient loading, along with increased symbiont densities, likely increasing ROS and oxidative stress. Yet, qPCR and ELISA experiments revealed a decrease in histone H2A.X gene expression and S139 phosphorylation (involved in DNA repair). These results are consistent with the notion suggesting that phosphorous starvation caused by nitrogen enrichment will limit coral capacity to repair DNA based on histone H2A.X phosphorylation, increasing coral susceptibility to bleaching and disease.

Keywords: histone variants, corals, DNA methylation, phosphorus starvation, acclimation, global change

EFFECTS OF SUBMARINE GROUNDWATER DISCHARGES ON BENTHIC COVER AND REEF RUGOSITY IN PUERTO MORELOS, QUINTANA ROO

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In the Caribbean, most coral reefs have undergone a phase shift from coral to macroalgae-dominated benthic communities, which reduces the available substrate for coral recruitment, affecting its survival, distribution and, eventually, the structural complexity of the system. The change in structural complexity (decreasing rugosity) generates significant losses of ecosystem services (e.g. coastal protection and shelter of species). The causes of phase shift are multiple; however, recent studies suggest that continental water input can contribute significantly. The present study shows evidence of these inputs flowing directly into the reef crest, through submarine groundwater discharges (SGDs), and its effect on the ecosystem in Puerto Morelos, Q. Roo. Using oceanographic instrumentation, high resolution bathymetric profiles (DGPS + Echosounder) were obtained to characterize reef rugosity, videotransects to estimate benthic cover to morpho-functional groups (scleractinian corals, octocorals, sponges, macroalgae, seagrass, substrate), and salinity, temperature and nitrate measurements (CTD + SUNA) to determine the influence of SGDs. Water samples were taken to complete and calibrate SUNA information. In addition, instruments (ADCPs + CTDs) were installed fixed on the sea bottom, to study the dispersion of SGDs on the reef and its lagoon. Measurements show consistent decrements of salinity with one month duration (during October-November 2016) reaching minimum values of 15 psu at sites influenced by SGDs. These sites show contrasting effects as compared to the reference sites (i.e. Limones), such as a macroalgae-dominated benthic cover, and reduced rugosity, especially where the algae are present. Evidence of this is observed in the rugosity index obtained for the reference profile and for at least four profiles along the lagoon. The results corroborate the negative influence of SGDs by reducing reef rugosity on the reef, which reduces numbers of habitats, potential for recover and enforces the demand for better sewage treatment practices in the area.

En el Caribe, la mayoría de los arrecifes han sufrido un cambio de fase, que ocurre cuando la cobertura escleractínea es disminuida en favor de una dominancia de macroalgas. Esto reduce el sustrato disponible para el reclutamiento del coral, afectando su supervivencia, distribución y, eventualmente, la complejidad estructural del sistema. El cambio en la complejidad estructural (decremento de rugosidad) genera pérdidas de servicios ecosistémicos (e.g. protección costera y refugio de especies). Las causas del cambio de fase son múltiples, sin embargo, recientes estudios sugieren que aportes continentales contribuyen significativamente. El presente estudio presenta evidencias en Puerto Morelos, Q. Roo de aportes de agua continental que desembocan en la cresta arrecifal, a través de descargas submarinas del acuífero (DSA), y su efecto en el ecosistema. Utilizando instrumentación oceanográfica se obtuvieron perfiles batimétricos de alta resolución (GPSd+Ecosonda) para caracterizar rugosidad arrecifal, videotransectos para estimar cobertura bentónica hasta grupos morfofuncionales (corales

escleractíneos, octocorales, esponjas, macroalgas, pastos marinos y sustrato), y mediciones de salinidad, temperatura y nitratos (CTD+SUNA) para determinar influencia de agua continental. Se tomaron muestras de agua para complementar y calibrar la información del SUNA. Adicionalmente se instalaron anclajes (ADCPs+CTDs) para estudiar la dispersión del agua continental en el arrecife y la laguna arrecifal. Disminuciones de salinidad durante un mes (Octubre 2016) y valores mínimos de 15 ups, se observaron en los sitios influenciados por DSAs. Estos sitios muestran efectos contrastantes comparados con sitios de referencia (Limones), como la composición del bentos que está dominada por macroalgas y rugosidad reducida, especialmente donde las algas están presentes. Evidencia de esto se observa en el índice de rugosidad obtenido para el perfil de referencia y por lo menos para otros cuatro a lo largo de la laguna. Los resultados corroboran la influencia negativa de las DSA en el arrecife, esto podría fortalecer la demanda por mejores prácticas de tratamiento de aguas residuales en la zona.

Keywords: Submarine Groundwater Discharges, Coral Reef, Roughness

LONG-TERM COASTAL EXPLOITATION AT HOLBOX ISLAND, MÉXICO.

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This study documents the history of fishing at Holbox Island through an interdisciplinary approach that integrates ecological, historical, archaeological, and fishers' traditional knowledge. The aim was to determine how small-scale fishing activities have contributed to declines in coastal resources and their near shore environments. Throughout 2016, we conducted 13 open interviews and 65 systematic surveys of fishers' perspectives on fisheries overexploitation, fishing practices, and knowledge of fishing sites. Survey results coupled with historical and archaeozoological data from excavations at the Mayan coastal site of Vista Alegre allow the construction of maps with baseline information long-term coastal exploitation. Preliminary results identify over 90 near shore fishing sites that were once very productive, including 40 highly species (i.e. Carcharhinidae, Lamnidae, Shpyrnidae, Pristidae, Cheloniidae) over the past 40 years. Additional data from archaeozoological remains (n= 545) of aquatic fauna identified 33 families of exploited taxa, of which finfish (i.e. Haemulidaea, Ariidae, Serranidae), sharks (i.e. Carcharhinidae), and sea turtles, were the most abundant. Fishers' and literature sources (n= 50) report increasing fishing effort through the mid 20th century, overfishing of higher trophic level fish, and contemporary illegal fishing in lagoonal sites. Combining these types of data (fishers' perspectives, interdisciplinary literature, historical and archaeozoological data), using historical ecology techniques and geospatial tools, we are generating novel baseline information on coastal development activities that is essential for understanding the conservation needs of the Island's natural and social resources.

El conocimiento tradicional de la pesca relacionado a biodiversidad de recursos pesqueros y los cambios de estos a través del tiempo se ha convertido en un tema relevante a nivel mundial. La documentación de dicho conocimiento es el objetivo de este estudio el cual documenta la explotación costera de la región, así como los cambios en la biodiversidad de recursos pesqueros y distribución de hábitats de pesca. Se empleó un enfoque interdisciplinario (biología marina, arqueología, geografía, historia ecológica), que incluyo la colaboración de pescadores y miembros de la comunidad de Isla Holbox y Chiquilá. Se realizaron entrevistas abiertas (n=13) y encuestas sistemáticas (n=65) relacionadas con la percepción de los pescadores respecto a la explotación y prácticas pesqueras, así como de los sitios tradicionales de pesca. Los resultados de las encuestas

se integraron con datos históricos y arqueológicos del sitio prehispánico de Vista Alegre para la elaboración de mapas con información de línea base que describen la explotación pesquera en Holbox. Resultados preliminares muestran más de 90 sitios de pesca que han sido históricamente productivos para la pesca artesanal con más de 40 especies explotadas en los últimos 40 años. Los restos arqueológicos (n=545) muestran la explotación de peces óseos, tiburones y tortugas. La información de los pescadores y datos literarios señalan una intensificación de presión pesquera en la segunda mitad del siglo XX, con mayor impacto en peces con mayor nivel trófico (e.g. chernas, meros). Además, se documentó que la pesca ilegal es común en la laguna de Yalahau. La información obtenida proporciona una visión integral de los hábitats y recursos explotados en la isla a través del tiempo. Esta información constituye una línea base de los recursos pesqueros en Isla Holbox, que puede ayudar para la generación de estrategias de manejo que favorezcan la preservación del capital natural y social de la Isla.

Keywords: Holbox Island, coastal exploitation, traditional knowledge, interdisciplinary science

SEAGRASSES OF COSTA RICA: FROM THE MIGHTY CARIBBEAN TO THE DYNAMIC MEADOWS OF THE EASTERN TROPICAL PACIFIC

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Seagrass meadows are declining worldwide, mostly due to anthropogenic disturbances. In face of this decline it is urgent to understand the dynamics of these meadows in order to establish adequate management and conservation strategies. Here, we analyzed the current knowledge on the seagrass meadows in the Caribbean and Pacific coasts of Costa Rica, Central America. Current knowledge was based on literature searches, herbarium collections and informal interviews. We report a total of five genera and seven species for Costa Rica: *Thalassia testudinum*, *Syringodium filiforme*, *Halophila decipiens*, *Halophila baillonis*, *Halodule wrightii*, *Halodule beaudettei*, and *Ruppia maritima*. Six species are reported for the Caribbean, and four species for the Pacific. *T. testudinum*, *S. filiforme*, and *H. decipiens* have only been reported for the Caribbean. *H. beaudettei* has only been reported for the Pacific coast. *H. baillonis*, *H. wrightii* and *R. maritima* have been reported for both coasts. Seagrasses were found at a total of 30 locations in Costa Rica; the majority from the Pacific coast, of which 15 are first reports. Seagrass meadows from both coasts are vastly different. Along the Caribbean coast, meadows are often dominated by the robust *T. testudinum*, which are extensive and stable, persisting for decades. In contrast, the meadows along the Pacific coast are more dynamic and are dominated by pioneer and ephemeral species, such as *H. baillonis* and *H. beaudettei*. The number of studies on Costa Rican seagrasses is scarce but has been increasing over time, mostly concerning taxonomy, and the dynamics of the seagrass *T. testudinum* from the Caribbean. Conservation and management efforts on Costa Rican seagrass meadows would benefit from continued monitoring and research on ecosystem resilience and services, incorporating associated fauna and flora.

Las praderas de pasto marino están deteriorándose a nivel mundial, ligado a disturbios antropogénicos. Esta degradación resalta la necesidad de entender las dinámicas ecológicas de estos sistemas costeros para definir estrategias de manejo y conservación adecuadas. Aquí, nosotros analizamos el conocimiento actual sobre praderas de pastos marinos en las costas Caribe y Pacífico de Costa Rica. El conocimiento actual se basó en revisiones de literatura, colecciones de herbarios y entrevistas. Reportamos un total de cinco géneros y siete especies para Costa Rica: *Thalassia testudinum, Syringodium filiforme, Halophila decipiens, Halophila baillonis, Halodule wrightii, Halodule beaudettei y Ruppia maritima*. Se reportan seis especies para el Caribe y cuatro especies para el Pacífico. *Thalassia testudinum, S. filiforme y H. decipiens* solamente han sido reportadas para el Caribe. Halodule beaudettei está solamente en la costa Pacífica. *Halophila baillonis, H. wrightii* y *R. maritima* son reportadas para ambas costas. Se encontraron pastos marinos en un total de 30 sitios en Costa Rica, la mayoría en el Pacífico; 15 de los cuales se reportan aquí por primera vez. Las praderas de pastos marinos de ambas costas son sumamente diferentes. En el Caribe, hay praderas extensas

dominadas por una especie grande, *T. testudinum*, las cuales han estado presentes por décadas. En contraste, las praderas en la costa Pacífica son más dinámicas ya que están dominadas por especies pioneras y efímeras, principalmente *H. baillonis y H. beaudettei.* El número de estudios sobre pastos marinos en Costa Rica es limitado, pero ha estado creciendo de manera constante, enfocándose principalmente en reportes taxonómicos y ecología de *T. testudinum* en la costa Caribe. Esfuerzos de investigación, conservación y de manejo se verían beneficiados por una continuación del monitoreo e investigación detallada en pastos marinos, pero también en la resiliencia del ecosistema y su
s servicios, incorporando la flora y fauna asociada.

Keywords: Seagrass meadows, coastal wetlands, Eastern Tropical Pacific, Caribbean, Central America, inventory

ACROPORA SPP. RESTORATION EFFECTS ON REEF COMMUNITY RESPONSE IN THE CARIBBEAN

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Coral reef ecosystems are home to ecologically and commercially important species that allow for essential ecosystem services to coastal communities such as coastal protection, food, and tourism. Unfortunately, there has been a worldwide decline in coral cover due to unsustainable human activity. As a response to reef loss, the active supplementation of a coral population unto the reef (outplanting) is currently the most important conservation strategy. In the Caribbean, however, proper assessments of the reef community's response to coral outplants are rare or non-existent. Thus, the purpose of our study is to: Evaluate the recovery of several important species and ecosystem function across outplanting sites that have been subject to differing levels of *Acropora* spp. outplanting efforts in the Caribbean. We used a 30m transect to document the benthic community composition every 20cm and measured every hermatypic coral that intercepted the line in restored reefs and non-restored reefs at six sites in the Caribbean (Guana Island, St. Croix, Dominican Republic, Bahamas, Jamaica, and Belize). We assessed fish diversity by surveying along the transect line with a span of 0.75m to each side. Results show significant difference in Acropora cervicornis densities ($p<0.034$) across restored and unrestored sites suggesting restoration success of the focal species. There was a non-significant trend between species densities and functional groups across treatments, with higher densities in restored sites. These results suggest that ecosystem recovery may: 1. Increase over time with a persisting A. cervicornis population survivorship, 2. Require higher restoration effort, and 3. Require new restoration approaches (i.e. multi-species restoration).

Keywords: *Acropora cervicornis*, coral restoration, ecosystem function

COMMUNITY-BASED SCIENTIFIC CITIZENS: A STRATEGY TO MANAGE COASTAL RESOURCES IN RESPONSE TO THE EFFECTS OF CLIMATE CHANGE

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Given the demand and misuse of natural resources our ecosystems have lost the ability to self-support. Climate change has rise global and regional issues, most alarming to coastal communities are the shoreline erosion and sea level rise. With over 435 Kilometer of coastline on 44 municipalities (57%) in Puerto Rico many hotels, residences and business are in threat. To protect our coastal resources is necessary to improve the understanding and management of them by the scientific and general community. By sharing scientific information with coastal communities will benefit the ecosystems to be restored to their functional state, where they can recreate a sustainable resource cycle. The non-governmental organization Sociedad Ambiente Marino (SAM) has a history of more than two decades of implementation of social strategies in coastal communities while empowering volunteers with skills and knowledge providing them with solid tools to fulfill their purpose in the conservation of the coastline with healthy coral reefs. The preoccupation, concern about the coastal erosion and sea level rise, plus the interest, love and passion for the sea, shared by these volunteers are great sources of motivation to protect their backyard. This symbiosis of ecological knowledge and socio participation has provided the SAM with relevant information for future studies and has been the source of information for over 100 presentations in more than 14 international scientific meetings, generating over 25 publications in scientific peer reviewed journals. With the collaboration of the scientific citizens volunteers, the SAM will continue to change paradigms and promote knowledge with the firm intention to accomplish the recovery, conservation and sustainability of coral reefs protecting our coasts.

Dada la demanda y el mal uso de los recursos naturales, nuestros ecosistemas han perdido la capacidad de autosuficiencia. El cambio climático ha aumentado los problemas mundiales y regionales, lo más alarmante para las comunidades costeras son la erosión de las costas y el aumento del nivel del mar. Con más de 435 Kilómetros de costa en 44 municipios (57%) en Puerto Rico muchos hoteles, residencias y negocios están en peligro. Para proteger nuestros recursos costeros es necesario mejorar la comprensión y el manejo de los mismos por la comunidad científica y general. Al compartir información científica con las comunidades costeras, los ecosistemas se beneficiarán para restaurar su estado funcional, donde pueden recrear un ciclo sostenible de recursos. La organización no gubernamental Sociedad Ambiente Marino (SAM) tiene más de dos décadas de implementación de estrategias sociales en las comunidades costeras, al mismo tiempo que habilita a los voluntarios con habilidades y conocimientos que les proporcionan herramientas sólidas para cumplir con su propósito en la conservación de la costa con arrecifes de coral. La preocupación, e inquietud por la erosión costera y la elevación del nivel del mar, más el interés, el amor y la pasión por el mar, compartida por estos voluntarios son grandes fuentes de motivación para proteger su patio trasero. Esta simbiosis de conocimiento ecológico y participación social ha proporcionado a la SAM

información relevante para futuros estudios y ha sido fuente de información para más de 100 presentaciones en más de 14 reuniones científicas internacionales, generando más de 25 publicaciones en revistas científicas revisadas por pares. Con la colaboración de voluntarios científicos, la SAM continuará cambiando paradigmas y promoviendo conocimiento con la firme intención de realizar la recuperación, conservación y sostenibilidad de los arrecifes coralinos que protegen nuestras costas.

Keywords: Scientific Citizens, Volunteers, Climate change, NGO, Coastal Communities, Sustainability

GIANT BARREL SPONGES, *XESTOSPONGIA MUTA*, ARE DOMINANT STRUCTURES ON A CARIBBEAN REEF.

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Coral reefs have been increasingly impacted by anthropogenic disturbances over the last half century threatening global biodiversity, ecosystem function, and the livelihoods of millions of people from mostly coastal resource-dependent communities. Specifically, Caribbean reefs have experienced mass disease-induced mortality of the herbivorous urchin *Diadema antillarum* and structurally dominant branching *Acropora* spp. corals as well as systemic overfishing, chronic nutrient enrichment and a series of coral bleaching events. Declining reef health here has largely been characterized by deterioration in hard coral cover and a phase shift to macroalgal cover. However, sponges are also a dominant component of Caribbean reef benthos and play critical roles in the ecological functioning of such communities, including the provision of habitat, food, and biogeochemical cycling, as well as acting as bio-eroders and competitors for space. Especially with the losses in coral cover, the present conditions on many reefs are suitable for sponge growth and proliferation. The giant barrel sponge, *Xetospongia muta*, is the largest, most conspicuous, longest-lived and second highest occurring sponge species on Caribbean reefs and has been noted to be expanding significantly in some areas. In this pilot study we examine the population size structure, density and cover of the giant barrel sponge on a single reef at Glover's Atoll, Belize. The observed dominance of *X. muta* at the study site may have serious implications for a number of ecosystem functions. As such, *X. muta* would be important to monitor as part of expanded benthic surveys that include many of the most frequently occurring sponge species. The monitoring and conservation of spongivorous vertebrate species (e.g. angelfishes, marine turtles) will also be a critical component of future reef management objectives as the environment for calcifying organisms, including hard corals, becomes increasingly challenging in light of climate change and associated ocean acidification.

Los arrecifes de coral han sido cada vez más afectados por disturbios antropogénicos durante el último medio siglo que amenazan la biodiversidad global, la función de los ecosistemas y los medios de vida de millones de personas procedentes en su mayoría de comunidades dependientes de recursos costeros. Específicamente, los arrecifes caribeños han experimentado la mortalidad masiva inducida por la enfermedad del erizo herbívoro Diadema antillarum y la ramificación estructuralmente dominante Acropora spp. Corales, así como sobrepesca sistémica, enriquecimiento crónico de nutrientes y una serie de eventos de blanqueamiento de corales. La disminución de la salud de los arrecifes aquí se ha caracterizado en gran parte por el deterioro de la cubierta de coral duro y un cambio de fase hacia la cobertura de macroalgas. Sin embargo, las esponjas son también un componente dominante del bentos boreal del Caribe y juegan papeles críticos en el funcionamiento ecológico de tales comunidades, incluyendo el abastecimiento del habitat, del alimento, y del ciclo biogeoquímico, así como del bio-eroders y de los competidores para el espacio. Especialmente con las pérdidas en la cubierta coralina, las

condiciones presentes en muchos arrecifes son adecuadas para el crecimiento y la proliferación de la esponja. La esponja de barril gigante, X. muta, es la especie de esponja más grande, más conspicua, de mayor longevidad y la segunda de mayor importancia en los arrecifes del Caribe, y se ha observado que se está expandiendo significativamente en algunas áreas. En este estudio piloto examinamos la estructura del tamaño de la población, la densidad y la cobertura de la esponja de barril gigante en un solo arrecife en Glover's Atoll, Belice. La dominancia observada de X. muta en el sitio del estudio puede tener serias implicaciones para una serie de funciones del ecosistema. Como tal, X. muta sería importante para monitorear como parte de las prospecciones ben tónicas expandidas que incluyen muchas de las especies de esponjas más frecuentes.El monitoreo y conservación de las especies de vertebrados esponjosos (por ejemplo, peces ángel, tortugas marinas) también será un componente crítico de los futuros objetivos de manejo de los arrecifes, ya que el ambiente para calcificar organismos, incluyendo corales duros, se vuelve cada vez más difícil a la luz del cambio climático y la acidificación asociada de los océanos.

Keywords: sponges, structure, population, community, ecosystem function, phase shift

A HISTOPATHOLOGICAL SURVEY OF QUEEN CONCH, *LOBATUS GIGAS*, HEALTH IN ST KITTS

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Queen conch, *Lobatus gigas*, sustains one of the largest commercial fisheries in the Caribbean. However, concerns over sustainable fishing have arisen since the collapse of stocks due to overharvesting. *L. gigas* populations are not replenishing as anticipated despite fishing restrictions and international conservation initiatives. Depleted and fragmented populations are at high risk of stochastic events such as disease epidemics; however, there is a paucity of literature regarding queen conch disease and the few reports of pathology did not use histological techniques. A histopathological survey was conducted to assess the health status of St Kitts queen conch populations. A standard dissection and sampling protocol was established and used to facilitate identification and description of pathology in sixty-one conch specimens sampled randomly/haphazardly? from fishermen at St Kitts. Pathology was observed in 13% (8/61) of the sampled population. Pathology mostly comprised internal parasitism (n = 5), especially encysted metazoan parasites, which were observed in the gill, digestive gland and large intestine, and likely comprise digenean metacercaria. Parasitism appeared to have little impact on the hosts' health and response to the infection was minimal. There were three cases of mild focal inflammation of unknown etiology in the mantle and gonadal tissues. Two cases of a congested and prolapsed anus were also seen but thought to be related to handling and extraction from shell. Disease appears to be uncommon in *L. gigas* caught by fisherman at St. Kitts. Pathologies observed elsewhere, such as imposex or apicomplexan infection of the digestive gland, could not be substantiated in our study population. High predation rate on diseased queen conch may yield underrepresentation of pathology. Future disease surveys could target stunted individuals, or those showing unusual behavior.

Keywords: gastropod pathology disease parasitism

COMPARISON OF CHEMICAL COMPOUNDS ASSOCIATED WITH SCLERITES FROM HEALTHY AND DISEAED SEA FAN CORALS (*GORGONIA VENTALINA*)

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The roles of gorgonian sclerites as structural components and predator deterrents have been widely studied. Yet, their role as barriers against microbes has only recently been investigated, and even less is known about the diversity and roles of the chemical compounds and mineral composition associated with the sclerites. Here, we examine the volatile organic compound fraction (VOCs) associated with sclerites from healthy and diseased Gorgonia ventalina sea fan corals to understand their possible role as a stress response or in defense of infection. We identified those chemical compounds that are present in sclerites, measured the oxidative potential of these compounds, and analyzed the mineral composition sclerites from diseased and healthy G. ventalina colonies. The results showed that sclerites harbor a great diversity of VOCs. Overall, 70 compounds were identified, the majority of which are novel with unknown biological roles. The majority of VOCs identified exhibit multiple immune-related roles including antimicrobial, antifungal and radical scavenging functions. The free radical activity assays further confirmed the anti-oxidative potential of some these compounds. The anti-oxidative activity was, nonetheless, similar across sclerites regardless of the health condition of the colony, although sclerites from diseased sea fans display slightly higher anti-oxidative activity than the healthy ones. No differences in the mineral composition were detected regardless of the health state of the corals suggesting that the health state of the corals have intangible effects on the mineralization of the sclerites.

Keywords: sea fans, arpergillosis, chemical defenses

HABITAT SUITABILITY FOR SEA TURTLES IN THE GULF OF MEXICO: A FUTURE SCENARIO

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Marine turtles are highly vulnerable species to variations in environmental temperature, having effects on their physiology, behavior, and even on their spatial and temporal distribution. It is reported that the shifting of temperate masses of water towards poles has caused the change of the distribution range of some of these species and the alteration of their feeding habitats. Five of the six marine turtle species inhabit the Gulf of Mexico (GoM), where they find critical habitats to complete their life cycle, and for which it has been projected sea surface temperature variations of up to 6°C. Despite the high influence of temperature on marine turtles, evaluations of changes in their range of distribution caused by climate change are scarce, and one approach to do it is using models based on the niche theory. The objective of this study was to evaluate projections of the geographical distribution for the five marine turtle species in year 2100 using habitat suitability models in the GoM in a SRES B1 climate change scenario. The nowadays and future geographical distributions for the five species that inhabit the GoM were obtained. It was observed that these species use different geographical and environmental spaces, and under a climate change scenario, the habitat suitability drastically diminishes in the most of the present suitable areas. The most affected species was *Dermochelys coriacea*, followed by *Chelonia mydas*, which lost large present suitable areas. This study gives a scenario of the climate change impacts on the distribution of marine turtles in the region of Gulf of Mexico.

Las tortugas marinas son altamente vulnerables a variaciones en la temperatura ambiental, con repercusiones en su fisiología, comportamiento e incluso distribución espacial y temporal. Se ha documentado que debido al corrimiento de las masas de agua templada hacia zonas polares algunas especies han incluso variado su rango de distribución y modificado sus hábitats de alimentación. En el Golfo de México habitan cinco de las seis especies de tortugas marinas; donde encuentran los hábitats críticos para completar su ciclo de vida; áreas en las que, en un escenario conservador de cambio climático, se esperan variaciones de hasta 6°C en la temperatura superficial marina. A pesar de la influencia de la temperatura en las tortugas, son escasas las evaluaciones de cambios en sus rangos de distribución por efectos del cambio climático, y una aproximación utilizada para tales estudiosos a través de modelos basados en la teoría del nicho ecológico. El objetivo de este trabajo fue evaluar las proyecciones para el año 2100 de la distribución geográfica de las tortugas marinas utilizando modelos de idoneidad ambiental en el Golfo de México ante el escenario SRES B1 de cambio climático. Se obtuvieron los modelos y las distribuciones geográficas actuales y futuras para las cinco especies de tortugas

marinas que habitan en la región. Se observó que estas especies utilizan espacios ambientales y geográficos diferentes y que, en un escenario de cambio climático, la probabilidad de idoneidad de sus hábitats disminuye drásticamente en la mayor parte de las áreas que actualmente son idóneas. La especie más afectada sería la *Dermochelys coriacea*, seguida de la Chelonia mydas que presentan la pérdida de grandes espacios idóneos actuales. Con este trabajo se provee un escenario de los impactos del cambio climático en la distribución de las tortugas marinas dentro de la región del Golfo de México.

Keywords: Spatial distribution, Niche ecology, Sea surface temperature, Climate change

EVIDENCE OF STRONG DENSITY-DEPENDENT LOSSES SOON AFTER SETTLEMENT FOR SPARISOMA PARROTFISHES ALONG THE WEST COAST OF BARBADOS

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Parrotfishes help sustain coral reef fisheries in many locations across the Caribbean and perform key ecological functions on the reefs. Whereas there has been considerable research focusing on parrotfish biology and ecology, we know little about the factors influencing parrotfish distribution and abundance soon after settlement, a critical period in the life history of reef fishes. In this study, we periodically monitored the distribution and abundance of recently settled *Sparisoma* (size range: 1-5 cm SL) on permanent quadrats deployed on three reefs along the west coast of Barbados, following a settlement peak. We used these data to (1) examine microhabitat associations of different size classes of *Sparisoma*; (2) examine spatial variability in density-independent and –dependent post-settlement losses in recently settled *Sparisoma;* and (3) investigate potential associations between post-settlement *Sparisoma* losses and microhabitat features. We found significant evidence of (1) a microhabitat use shift from dead coral covered by turf algae to dead coral covered by encrusting coraline algae within the smallest *Sparisoma* size classes (<2cm SL); (2) strong (and spatially variable) density-dependent *Sparisoma* losses soon after settlement, which ultimately distorted *Sparisoma* abundance patterns originally established at settlement, and (3) associations between the strength of density-dependent Sparisoma losses and certain microhabitat features. Overall, these results indicate that *Sparisoma* populations along the west coast of Barbados might suffer a population bottleneck driven by the availability of suitable early post-settlement microhabitat.

Keywords: *Sparisoma*; parrotfishes; density-dependence; microhabitat use;

SEVERE IMPACTS OF *SARGASSUM* SPP. BROWN TIDES ON NEAR-SHORE SEAGRASS COMMUNITIES IN THE CARIBBEAN

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From 2011 until 2016, unprecedented masses of pelagic seaweed *Sargassum* spp. were reported throughout the Caribbean and along the west coast of tropical Africa. The Mexican Caribbean coast experienced a massive influx of *Sargassum* spp. from mid-2014 until the end of 2015. These masses accumulated on the shores, resulting in build-up of decaying beach-cast material and near-shore murky brown water. We named this phenomenon *Sargassum*-brown-tide (Sbt). The effects of Sbt on four near-shore seagrass meadows included reduction in light, oxygen (hypoxia or anoxia) and pH, and increased temperature and ammonia concentration. The monthly influx of nitrogen by drifting *Sargassum* spp. was estimated at 6150 kg km-^{1}, and for phosphorus this was 61 kg km-^{1}, which were respectively, ~30 and ~3 -10 times the usual monthly inputs into the sea through ground-water discharge. Near-shore seagrass meadows dominated by *Thalassia testudinum* were replaced by a community dominated by calcareous rhizophytic algae and drifting algae and/or epiphytes, resulting in 61.6 to 99.5% loss of below-ground biomass. Near-shore corals suffered total or partial mortality. Recovery of affected seagrass meadows is likely to take years or decades or changes could be permanent if massive influxes of *Sargassum* spp. recur. If recurring at intervals of years or decades, the system will change permanently, resulting in increased eutrophication and loss of the ecosystem services provided by the near-shore seagrass meadows, such as facilitating biodiversity, increasing water transparency and beach stabilization.

Keywords: *Sargassum*, Algal-bloom Anoxia, Seagrasses, Corals

RECOMMENDATIONS AND OUTCOMES FROM THE NOVEMBER 2016 WORKSHOP TO ADVANCE THE SCIENCE AND PRACTICE OF CARIBBEAN CORAL RESTORATION

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In November 2016, NOAA convened a Workshop to Advance the Science and Practice of Caribbean Coral Restoration occurred in Fort Lauderdale, Florida. The workshop fostered collaboration and technology transfer among coral restoration scientists, practitioners, and managers from 20 Caribbean nations, and initiated a community of practice that will continue to address the multiple, rapidly expanding and evolving paths to active coral restoration in the evolutionary history of coral reef ecosystems. The theme of scaling up restoration to meet the needs of ecosystem recovery was woven throughout sessions on coral genetics, improving outplanting techniques, updates on the role of larval propagation, restoration of non-acroporid species, monitoring to quantify restoration success at multiple scales, and more. Five recommendations emerged from the workshop (1) restore reefs in targeted geographic areas to decrease coastal wave propagation and flood-risk (2) dramatically increase the efficiency and scale of restoration in order to establish self-sustaining, sexually reproductive populations (3) develop monitoring guidelines that cover both basic and detailed levels of information and share data to facilitate regional understanding of ecosystem status (4) develop guidelines on several issues related to coral genetics (5) form a Coral Restoration Consortium to facilitate ongoing communication and progress. Highlights from the workshop will be presented along with the vision and structure of the consortium that is currently being formed.

Keywords: restoration, coral, Outplanting techniques

HOW DOES COLONY SIZE AND DENSITY INFLUENCE PATERNITY IN A BROODING CORAL?

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Multiple natural and anthropogenic stressors have caused a decline in coral populations. Broadcast spawning corals once dominated the Florida Reef Tract (FRT), but since their decline, smaller brooding corals, soft corals, and macroalgae are replacing them. Brooding corals are more resilient to current threats in part because they are reproductive throughout much of the year and their larvae are competent to settle after release. Despite the ubiquity of brooders on Florida reefs, much of their reproductive strategy remains unknown. This study examines paternity as a function of colony size and density in *Porites astreoides*, a common brooding coral in the FRT. A focal colony of *P. astreoides* was surrounded by six other colonies, separated from the focal colony at different distances (1m, 7m, and 15m) representing high, moderate, and low population densities, respectively. Each array was replicated three times. Colonies were transported to the laboratory for larval collection and the resulting larvae were genotyped using eight microsatellite markers. Over a four day period, a total of 3,184 larvae were collected from 22 colonies, 13 of which released larvae over consecutive days. Understanding the paternity in common brooding corals is important to effectively assess and conserve Florida's shifting coral reef communities.

Keywords: coral, genetics, larvae, paternity, Porites

OCTOCORAL DISEASES IN A CHANGING OCEAN

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Octocorals (Cnidaria, Octocorallia) constitute a geographically and bathymetrically widely distributed and common group of marine invertebrates commonly referred to as soft-corals, gorgonians and sea plumes.. Octocorals are important members of most Atlantic-Caribbean, Indo-Pacific, and Mediterranean coastal and mesophotic communities; however, information about their susceptibility to diseases, predation, and competition, and their relationship with changing environmental conditions is limited. At least 17 diseases have been observed in at least 42 common octocoral species throughout their range. Twelve of these have been reported in the wider-Caribbean (CA), one in Brazil (BR), two in the Mediterranean (ME), one in the Eastern Pacific (EP), and three in the western Pacific (WP). Pathogenic and/or environmental causes have been identified for eight diseases, including terrestrial fungi, protozoan, bacteria and high temperature.. At least eight disease outbreaks have led to extensive octocoral mortalities in the CA, ME, BR, and EP with detrimental ecological consequences. The fungal disease Aspergillosis has produced the highest mortalities in the CA and the EP. Bacterial and fungal agents seemed to be responsible for the mass mortalities in the ME, BR and WP. Most outbreaks in all regions were linked to high thermal anomalies associated with climate change, which seems to be the major driver. Other biological stressors such as predation and/or competition produce injuries that may contribute to spread of infections and mortality. New diseases are being described almost every year concomitant with increasing seawater temperatures. The ecological and economic consequences could be devastating, with drastic changes in the seascape of shallow coral reefs and other coastal marine habitats and reduction of their ecological services. Given our limited knowledge, our best options for recovery of octocorals and coral reefs in general include sound management of coastal fisheries, control tourism, reduction of land- and sea-based pollution, and abating effects of climate change.

Keywords: Diseases, octocorals, World-wide epizootics, mass mortalities, Thermal anomalies, Climate change

REGIONAL-SCALE ELEVATION CHANGES IN MODERN CORAL REEF ECOSYSTEMS

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Healthy coral reefs serve as natural barriers that protect adjacent shorelines from coastal hazards, such as wave impacts from storms. Recent predictions, however, assert that anthropogenic impacts and climate change will cause the global degradation of coral reefs, leading to a net-erosional state by mid-century. To date, no studies have measured regional-scale elevation changes of coral reef ecosystems. We developed analysis techniques that used both contemporary bathymetric LiDAR and historical sounding data to estimate spatial variability in the amount of accretion and erosion for 5 coral reef ecosystems in the Atlantic, Pacific and Caribbean over the last several decades. Regional-scale mean-elevation and volume losses were observed at all 5 study sites, and in 77% of the 60 individual habitats that we examined across all study sites. Mean seafloor elevation losses for whole coral reef ecosystems in our study ranged from -0.09 m to -0.8 m, corresponding to net volume losses ranging from 3.4 to 80.5 million-cubic-meters for all study sites. Erosion of both coral-dominated substrate and non-coral substrate suggests that the current rate of carbonate production is no longer sufficient to support net accretion of coral reefs or adjacent habitats. This transition to a net-erosional state is effectively accelerating the rate of relative sea-level rise in these regions. Our results set a new baseline for projecting future impacts to coastal communities resulting from degradation of coral reef systems and associated losses of natural and socio-economic resources.

Los arrecifes de coral saludables actúan como barrera natural protegiendo las orillas adyacentes de peligros costeros tales como el impacto de las olas producidas por tormentas. Sin embargo, predicciones recientes afirman que impactos antropogénicos y cambios climáticos causaran la degradación global de arrecifes de coral, provocando una erosión neta para mediados del siglo. Hasta la fecha no ha habido estudios que midan cambios de elevación en ecosistemas de arrecifes de coral a escala regional. Nosotros desarrollamos técnicas de análisis que utilizaron LiDAR batimétrico contemporáneo y datos históricos de sondeo para estimar la variación espacial de la cantidad de acreción y erosión de las últimas décadas en 5 ecosistemas de arrecifes de coral en el Atlántico, el Pacífico y el Caribe. Se observaron pérdidas de volumen y de elevación promedio a escala regional en los 5 lugares y un 77% de los 60 hábitat individuales estudiados. La pérdida promedio del fondo marino en todos los ecosistemas de arrecife de coral en nuestro estudio oscilaron entre -0.09 m y -0.08 m, esto corresponde a una pérdida de volumen neta entre 3.4 a 80.5 millones de metros cúbicos. La erosión del substrato dominado por corales y la de no-corales sugiere que la tasa actual de producción de carbonato ya no es suficiente para sostener la acreción neta de arrecifes de coral o hábitat adyacentes. Esta transición a un estado de erosión neta está acelerando la tasa relativa del aumento del nivel del mar en estas regiones. Nuestros resultados establecen una nueva base de referencia para proyectar futuros impactos a las comunidades costeras afectadas

por la degradación de sistemas de arrecife de coral y por consiguiente de la pérdida de recursos naturales y socioeconómicos.

Keywords: seafloor erosion, lidar, elevation-change modeling

ALGAL MORPHOFUNCTIONAL GROUPS FROM NATURAL PROTECTED AREAS IN THE NORTHERN COAST OF THE YUCATAN PENINSULA, MEXICO

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We used an Algal Morpho-Functional Groups (AMG) approach to study the structure of algal dominated communities in two natural protected areas (NPAs), Dzilam de Bravo and the Palmar, in the northern coast of the Yucatan Peninsula, Mexico. This approach is underpinned on the relationship of form and function as an indicator to understand the patterns on macroalgal distribution and identify certain factors (either biotic or abiotic) of relevance. We propose the modification of the classification of Steneck and Dethier adding two more categories. For each NPA, we sampled three sites at two depths each (2.5 and 5 m) during north fronts, the dry season and the wet season, from November 2005 to July 2006. Additionally, we conducted a floristic analysis to determine the species richness, along with the classification of morphofunctional groups. We determined the relative abundance and applied a MFG similarity analysis, and found a total of 67 algal species, 54 species in the Palmar and 51 in Dzilam de Bravo, for a total of seven morphofunctional groups. In both ANP´s, corticated macrophytes were more abundant. The AMG similarity analysis between the NPAs was under 50%, while the temporal distribution on MFG varied little for each season, which means that the NPAs were relatively stable. The pattern in distribution for the algal species under the AMG approach was similar. We consider that the AMG approach may be a useful and effective tool to know the algae distribution without compromising the results obtained in demographic studies at the species level.

Para este trabajo se utilizó un enfoque de Grupos Morfofuncionales Algales (GMA) para estudiar la estructura de comunidades de macroalgas en dos áreas naturales protegidas (ANP), Dzilam de Bravo y Palmar, en la costa norte de la Península de Yucatán, México. Este enfoque se apoya en la relación de forma-función como un indicador para comprender los patrones de distribución de macroalgas e identificar ciertos factores (ya sean bióticos o abióticos) de relevancia. Para ellos proponemos una modificación a las clasificaciones previamente elaboradas. Para cada ANP, se muestrearon tres sitios a dos profundidades cada uno (2,5 y 5 m) durante las épocas de nortes, secas y lluvias, de noviembre de 2005 a julio de 2006. Adicionalmente, se realizó un análisis florístico para determinar la riqueza de especies, junto con la clasificación de grupos funcionales se determinó la abundancia relativa y se aplicó un análisis de similitud. Se encontró un total de 67 especies de algas,

54 en el Palmar y 51 en Dzilam de Bravo, clasificadas siete grupos morfo-funcionales. En ambas ANP las macrófitas corticadas fueron relativamente más abundantes. El análisis de similitud entre las ANP fue inferior al 50%, mientras que la distribución temporal presentó poca variación para cada temporada. El patrón de distribución de las especies de algas bajo el enfoque GMA fue similar. Consideramos que este enfoque puede ser una herramienta útil y efectiva para conocer la distribución de algas sin comprometer los resultados obtenidos en estudios demográficos a nivel de especie.

Keywords: Algal Morphofunctional Groups, Natural Protected Areas, Yucatan Peninsula, Macroalgae.

CALIPERS TO 3D MODELS: MEASURING THE SURVIVAL AND GROWTH OF FIVE REEF-BUILDING CORAL SPECIES ON IN SITU TREE NURSERIES, DISCOVERY BAY, JAMAICA.

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Coral restoration, by way of out-planting nursery-grown corals, strives to reestablish the structure and function of degraded coral reefs. To improve our understanding of reef-building species in coral restoration, a small-scale in situ coral nursery was established in Discovery Bay, Jamaica. Two different monitoring methods were used to evaluate coral growth. In May 2015, 60 fragments, four each from three donor colonies of five coral species (*Acropora palmata, Orbicella annularis, Orbicella faveolata, Undaria agaricites, Siderastrea siderea*), were prepared. Fragments were attached to cement bases and installed on coral tree nurseries positioned on the Discovery Bay fore-reef. Apart from visual observations of attachment success, monthly monitoring via caliper measurements and multi-angle, digital photographs revealed between-species variation in survival rate and growth rate (as measured by extension of living tissue). The development of high resolution 3D models of individual fragments provides a novel, innovative technique for accurately capturing the tissue extension and increased volume demonstrated by these nursery-grown corals over a period of 21 months. We make recommendations on the use of different coral species and nursery monitoring techniques to inform future larger scale reef restoration efforts in the Caribbean region.

Keywords: coral tree nursery, coral restoration, coral tissue, coral growth, 3D modelling, Jamaica, Caribbean

CYTOTOXIC EFFECT OF THE CUBOZOAN *CARYBDEA MARSUPIALIS* ON

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Tropical reefs are invaluable sources of pharmaceutical resources. While the vast majority of pharmaceutical benefits tropical reefs offer is still currently unknown, recent dramatic declines in tropical reef cover have increased the urgency to determine what pharmacological benefits tropical reefs offer. The current study examined a cubozoan sea jelly, which produces an array of toxic proteins, in particular cytotoxins. These cytotoxins are thermolabile, having a molecular weight between 42-46 kDa, known for their cytolytic activity, and specificity to cubozoans. Cubozoan cytotoxins have been tested as antitumorals, known to mainly affect cell division. Previous studies have described the molecular characterization toxins of *C. marsupialis*, finding haemolytic activity in human and sheep erythrocytes, neurotoxic activity in frog oocytes, and antitumor activity in rat induced tumors on the central nervous system by N-ethyl-Nitrosourea. In the current study, the crude extract from *C. marsupialis* that was pre-purified by centrifugal filter units and stirred ultrafiltration cell. Using the crude extract and pre-purified fractions phospholipase A2 activity was evaluated as well as cytotoxicity on cancerous cells. *C. marsupialis*, showed no phospholipase A2 activity. The >30 kDa pre-purified fraction showed cytotoxic activity against leukemia cells, inhibiting cell growth 88.17% at 8.5 µg/ml of protein concentration, a result that is higher than the positive control (Mitoxantrone), which inhibited cell growth 86.35%. In colon cancer cells, the same pre-purified fraction, at the same protein concentration, inhibited cell growth 2%. While cytotoxic activity was low for this sample, this is one of the first examples of cytotoxic activity against colon cancer cells produced by cubozoans. While cytotoxins of *C. marsupialis* showed activity against cancerous cells, no activity was seen for non-cancerous cells. The current decline in tropical reef abundance not only results in the loss of an ecosystem, but will also result in the loss of an invaluable pharmaceutical resource.

Los arrecifes tropicales como fuente invaluable de recursos farmacéuticos, ofrecen beneficios a la salud humana. Las dramáticas disminuciones en la cobertura arrecifal, han aumentado la urgencia de determinar estos *beneficios ofrecidos.* El presente estudio examinó las citotoxinas producidas por *Carybdea marsupialis*. Estas citotoxinas son termolábiles y con pesos moleculares que van desde 42-46 kDa, presentan actividad citolítica y se encuentran únicamente en cubozoos. Han sido probadas como antitumorales sabiendo que actúan sobre la división celular principalmente. Estudios previos han descrito la caracterización molecular de *C. marsupialis*, encontrando actividad hemolítica en eritrocitos de humano y oveja, actividad neurotóxica en ovocitos de rana y actividad antitumoral en tumores inducidos en rata con N-etil-Nitrosourea. En el presente estudio, el extracto crudo obtenido de *C. marsupialis*, fue pre-purificado mediante las técnicas de ultrafiltración por centrifugado y filtración por célula de

agitación. Se evaluó la presencia de actividad enzimática de fosfolipasa A2 y actividad citotóxica en células cancerosas. C. marsupialis, no mostró actividad de fosfolipasa A2. La fracción pre-purificada de >30 kDa mostró actividad citotóxica en células leucémicas, inhibiendo el crecimiento celular 88.17% a 8.5 μg/ml de concentración de proteína, un resultado mayor que el control positivo (Mitoxantrona), que inhibió el crecimiento celular 86.35%. En células de cáncer de colon, la misma fracción pre-purificada a la misma concentración de proteína, inhibió el crecimiento celular 2%. Aunque la actividad citotóxica fue baja, éste es uno de los primeros ejemplos de actividad citotóxica contra las células cancerosas de colon producidas por cubozoos. Mientras que las citotoxinas de *C. marsupialis* mostraron actividad contra las células cancerosas, no se observó actividad en las células no cancerosas. La actual disminución de la abundancia de los arrecifes tropicales no sólo da lugar a la pérdida de un ecosistema, sino que también dará lugar a la pérdida de un valioso recurso farmacéutico.

Keywords: Cnidarians, cancer, sea jelly, cubozoa, cytotoxins, toxinology

EFFECT OF EXPOSURE TO HIGH TEMPERATURE IN CELLULAR RESPONSE OF CARIBBEAN SPINY LOBSTER, *PANULIRUS ARGUS*

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Understanding and predicting the impacts of global warming is now a central theme in ecology and physiology. Changes in temperature patterns can alter the circulation of the oceans and affect important processes such as reproduction, distribution and susceptibility to infectious diseases of marine organisms. Knowing the effect of temperature on the immune response may allow better understanding of changes in susceptibility to infectious diseases. Our objective was to determine the effect of exposure to a high temperature on the immunological cells of the lobster *Panulirus argus*. Wild organisms were collected in Quintana Roo, Mexico, which were kept in a semi-closed seawater system, and fed with a squid crab paste for a period of two months to homologate their physiological condition and thermal history. Subsequently they were distributed in six tanks, in three the same temperature was maintained (26°C), and in the rest it increased until reaching 32°C in 20 hours. After three days, hemolymph was obtained; counts and characterization of hemocytes were performed by microscopy. A paired analysis was used to compare the total concentration and the cellular subtypes. The total concentration and the semigranular cells showed no difference between the experimental groups. Nevertheless, the concentration of hyaline hemocytes decreased significantly in the organisms exposed to the high temperature treatment ($p < 0.005$), indicating possible alterations in the distribution of peripheral hemocytes or in the cellular viability. Further studies are needed to determine the effect on longer exposures and to evaluate other immune effectors to better understand the effects of high temperature exposure on the major defense mechanisms of *P. argus*.

Entender y predecir los impactos del calentamiento global es ahora un tema central en ecología y fisiología. Los cambios en los patrones de temperatura pueden alterar la circulación de los océanos y afectar importantes procesos como la reproducción, distribución y susceptibilidad ante enfermedades infecciosas de los organismos marinos. Conocer el efecto de la temperatura sobre la respuesta inmunológica puede permitir entender mejor los cambios en la susceptibilidad ante enfermedades infecciosas. Nuestro objetivo fue determinar el efecto de exposición a una alta temperatura sobre las células inmunológicas de la langosta Panulirus argus. Organismos silvestres fueron colectados en Quintana Roo, México, lo cuales fueron mantenidos en un sistema semi-cerrado de agua de mar, y alimentados con una pasta de jaiba calamar por un periodo de dos meses para homologar su condición fisiológica y su historia térmica. Posteriormente fueron distribuidos en seis tanques, en tres se mantu
vo la misma temperatura (26°C), y en el resto se incrementó hasta alcanzar los 32°C en 20 horas. A los tres días se obtuvo la hemolinfa por punción y se realizaron los conteos y la caracterización de los hemocitos por microscopia. Se utilizó una análisis pareado para

comparar la concentración total y de los subtipos celulares. La concentración total y las células semigranulares no mostraron diferencia entre los grupos experimentales. No obstante, la concentración de hemocitos hialinos disminuyó significativamente en los organismos expuestos al tratamiento de alta temperatura ($p < 0.005$), indicando posibles alteraciones en la distribución de los hemocitos periféricos y/o en la viabilidad celular. Hacen falta mas estudios para determinar el efecto en exposiciones mas prolongadas y evaluar otros efectores inmunológicos para entender mejor los efectos por la exposición a alta temperatura en los principales mecanismos de defensa de P. argus.

Keywords: Temperature, Physiology, Cellular response, Panulirus argus.

EFFECT OF EXPOSURE TO HIGH TEMPERATURE IN CELLULAR RESPONSE OF CARIBBEAN SPINY LOBSTER, *PANULIRUS ARGUS*

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comparar la concentración total y de los subtipos celulares. La concentración total y las células semigranulares no mostraron diferencia entre los grupos experimentales. No obstante, la concentración de hemocitos hialinos disminuyó significativamente en los organismos expuestos al tratamiento de alta temperatura ($p < 0.005$), indicando posibles alteraciones en la distribución de los hemocitos periféricos y/o en la viabilidad celular. Hacen falta mas estudios para determinar el efecto en exposiciones mas prolongadas y evaluar otros efectores inmunológicos para entender mejor los efectos por la exposición a alta temperatura en los principales mecanismos de defensa de P. argus.

Keywords: Temperature, Physiology, Cellular response, Panulirus argus.

GIANT BARREL SPONGE DENSITY ON MIDDLE AND OUTER SOUTHEAST FLORIDA REEFS

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Beginning in 2003, The Southeast Florida Coral Reef Evaluation and Monitoring Project (SECREMP) has allowed for annual data collection on the status of the Florida Reef Tract (FRT) from Martin County to Miami-Dade County providing information on long term benthic cover trends. Annual visits to permanent sites show changes in stony coral, octocoral, and barrel sponge demographics. The objective of this study is to focus on the giant barrel sponge, *Xestospongia muta*, to observe whether trends in barrel sponge density are comparable to the benthic cover trends of stony corals and octocorals observed in the same areas from the years 2013 to 2016. Data were collected at 6 permanent sites on the Southeast Florida portion of the FRT. At each site, barrel sponge data were collected on four, 22x1 meter transects. Results indicate an increasing trend of barrel sponge density in certain regions in comparison to decreasing stony coral cover. Further analysis of this data will be useful to show trends in benthic cover densities and potential shifts in functional groups on the FRT.

Keywords:

CORAL REEF BLEACHING AND CORAL DISEASES IN TOBAGO OVER 22 YEARS

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These conditions and diseases are related to the main theme of this meeting "Marine Science in a Changing Climate." We conducted 10 coral disease field surveys at 7 sites in northwest and southwest Tobago in 1981, 1983, 1997, and 2003. We found evidence of Barrel-sponge Crumbling Syndrome, Black-band Disease, Coralline-algae Lethal Disease, Coral-reef Bleaching (CRB), Dark-spot Disease, *Diadema antillarum* Mass Mortality, Finger Coral Syndrome, Mat Sea Squirt Overgrowth, Red-band Disease type I, Sea-fan Aspergillosis, Sea-turtle Fibropapillomatosis, Slime-blotch Disease, Sponge-overgrowth Condition, Sponge Wasting Disease, Stoplight Parrotfish Corallivory, Strep Fish Kills, White-band Disease (WBD), White Plague II, White Pox Disease, White-spot Syndrome, and Yellow-band Disease. Only seven of these 21 diseases and syndromes had previously been reported from Tobago. The formerly living coral reefs we examined in Man-of-War Bay in northwestern Tobago have died, and those examined in southwestern Tobago appear to be in decline. Diseases appear to have been a prominent part of this deterioration, but we cannot be certain if they represent a primary cause or an after effect of other stresses. Our results question the possible role of Sahara dust or river dispersion of pathogens since the number and abundance of these diseases are comparable with most other Caribbean sites, but Tobago is known to have one of the highest dust and river-water exposures in the region. One clonal row is a vast, dead, standing thicket of Elkhorn Coral, *Acropora palmata*, was alive. This may indicate resistance to CRB and/or WBD.

Keywords: Bleaching, diseases, Tobago, 23 years, Atlantic, Climate change.

HYPEROSTOSIS/OSTEOMAS IN THE ATLANTIC CUTLASSFISH, *TRICHURUS LEPTURUS* (PERCIFORMES: TRICHIURIDAE) AND SKIN SQUAMOUS PAPILLOMAS IN COROCORO GRUNTS, *ORTHROPRISTIS RUBER* (PERCIFORMES: HAEMULONIDAE) IN VENEZUELA

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These diseases may have some connection with the main theme of this meeting “Marine Science in a Changing Climate.” They may be responses to climate changes. Large bone masses [hyperostosis or osteomas] occurred commonly (35-40%) in Atlantic Cutlassfish, *Trichurus lepturus* (Perciformes: Trichiuridae) in the Gulf of Cariaco. These were up to 12.8 x 3.5 x 1.8 cm in size free-floating in the muscle tissue but attached to ribs or spines from which they originated. The osteomas are slow-growing, well differentiated, non-invasive, masses of irregular bone originating from osteoblasts (Registry of Tumors in Lower Animals RTLA 7028). Similar growths have been reported in this fish around the world, but not in the Caribbean, nor at such a large size. Squamous papillomas occurred in the skin of three Corocoro Grunts, *Orthropristis ruber* (Perciformes: Haemulidae), and tissue proliferations occurred in two others collected off Margarita Island, Venezuela. These were the only specimens affected out of 250 examined in eastern Venezuela. No tumors or tumor-like conditions had previously been noted in this fish.

KeyWords: Hyperostosis/Osteomas, cutlafish, skin squamous papilomas, grunts, Atlantic

CORAL REEF BLEACHING, CORAL DISEASES, AND MARINE PARASITES IN SABA, NETHERLANDS ANTILLES, OCTOBER 2005

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These conditions and diseases are related to the main theme of this meeting "Marine Science in a Changing Climate." The prevalence of these parasites may also be correlated with environmental changes. We examined the first major Coral Reef Bleaching event that occurred on the island of Saba. We evaluated bleaching in 87 species of stony corals, gorgonians, sea anemones, sponges, and jellyfish, and 24 species were severely bleached. Most corals in Saba form a thin coating on top of volcanic formations. This gives the appearance of large, old colonies and coral heads. An advantage of this system is that it can quickly recover from coral loss. The system also has the advantage of being in oceanic waters. Thus no coastal or confined sea water heating was involved, but a general ocean warming occurred. Therefore, corals on Saba should bleach less often and recover more rapidly than other parts of the Caribbean. Ironically, Saba with no coral reefs, could be one of the last places in the Caribbean to appear to have extensive coral reefs. We found Black Band Disease on Boulder Brain Coral, Seafan Aspergillosis commonly on Common Seafan, Sponge Zoanthid on Orange Ball Sponge, Hydroid Zoanthid on Feather Brush Hydroid, Reef-fish Turbellarian on Rockbeauty, Chromis Isopod on Brown Chromis, Grunt Isopod on the French and Bluestripe Grunts, Creolefish Isopod on Creolefish, Barracuda Skater on Great Barracuda, Elasmobranch Leech on a Caribbean Reef Shark. Seafan Aspergillosis was known on Saba, but other records are new. Isopods occurred much more commonly on inshore vs. offshore reefs.

KeyWords: Climate Change, diseases, bleaching, Caribbean, Saba.